EPA-R5-2019-004886_0000973

Feasibility Study Report

Allied Paper/Kalamazoo River—Operable Unit 1

Allied Paper/Portage Creek/Kalamazoo River Site

City of Kalamazoo, Michigan

Feasibility Study

WA No. 109-RICO-059B/Contract No. EP-S5-06-01

Prepared for

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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CH2MHILL®

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Acronyms and Abbreviations

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
the City	the City of Kalamazoo
COC	contaminant of concern
EO	Executive Order
FRDL	Former Residuals Dewatering Lagoon
FML	flexible-membrane liner
FS	feasibility study
GCL	geosynthetic clay liner
GDC	geosynthetic drainage composite
GRA	general response action
GSI	groundwater surface water interface
HRDL	Historic Residuals Dewatering Lagoon
IC	institutional control
IRM	Interim Response Measure
MDEQ	Michigan Department of Environmental Quality
µg/L	micrograms per liter
mg/kg	milligram per kilogram
MHLLC	Millennium Holdings, LLC
NREPA	Natural Resources and Environmental Protection Act of 1994
O&M	operation and maintenance
OU	operable unit
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PCOC	potential contaminant of concern
PRG	preliminary remediation goal
RAO	remedial action objective
RD	remedial design
RI	remedial investigation
RME	reasonable maximum exposure

ROD	Record of Decision
the Site	Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TCRA	time-critical removal action
TSCA	Toxic Substances Control Act
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
yd^3	cubic yards

SECTION 1

1 Introduction

The Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (the Site) is located in Allegan and Kalamazoo counties in southwest Michigan (Figure 1-1). The Site includes 80 miles of the Kalamazoo River, adjacent floodplains and wetlands, paper-residual disposal areas, and former paper mill properties, all pervasively contaminated with polychlorinated biphenyls (PCBs) as the result of the recycling of carbonless copy paper. The Site was listed on the National Priorities List in 1990; the State of Michigan posted fish advisories warning against any consumption of certain Kalamazoo River fish within the Site as early as 1977. The advisories remain in effect. Currently, the Site is divided into the following operable units (OUs):

- OU1: Allied Paper Landfill
- OU2: Willow Boulevard/A Site Landfill
- OU3: King Highway Landfill
- OU4: 12th Street Landfill
- OU5: Kalamazoo River and Portage Creek

This feasibility study (FS) report evaluates potential remedial alternatives that may be implemented at the Allied Paper Landfill/OU1. OU1 occupies 89 acres including Portage Creek between Cork and Alcott streets within the City of Kalamazoo (the City). Investigation efforts were carried out in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1996, and pursuant to an Administrative Order on Consent issued by the State of Michigan in 1990 (Final Order No. DFO-ERD-91-001). In 2008, the Michigan Department of Environmental Quality (MDEQ) summarized the remedial investigations in the *Allied Paper, Inc. Operable Unit Remedial Investigation Report* (remedial investigation [RI] report; MDEQ 2008). Upon finalization of the RI report, the U.S. Environmental Protection Agency (USEPA) assumed the responsibility of lead agency for the remainder of work to be done at OU1.

The FS is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions at a Superfund site. The RI and FS are conducted concurrently—data collected in the RI influence the development of remedial alternatives in the FS, which in turn affect the data needs and scope of treatability studies and additional field investigations. This report presents the remedial action objectives (RAOs), the identification and evaluation of remedial technologies, development of alternatives to address OU1-specific risks to human health and the environment, and the evaluation of the alternatives. The results of the RI report and recent supplemental investigation work were reviewed and incorporated throughout the FS process.

The FS report includes the following sections:

- Section 1: The background and history of OU1, a summary of prior release actions, potential contaminants of concern (PCOCs), and key elements in the RI report, findings of the recent Supplemental Groundwater Investigation Report, and USEPA's preliminary remedial goals (PRGs)
- Section 2: Identification of general response actions (GRAs), establishment of RAOs, identification of PRGs and contaminants of concern (COCs), and identification and development of possible federal and state applicable or relevant and appropriate requirements (ARARs)
- Section 3: Identification and review of technologies and process options, and presentation of a range of alternatives designed to achieve the risk-based RAOs established for OU1
- Section 4: Descriptions of the remedial alternatives developed for OU1
- Section 5: Analysis of each alternative relative to a series of evaluation criteria defined in CERCLA
- Section 6: Comparative analysis of the alternatives relative to the CERCLA evaluation criteria
- Section 7: References

1.1 OU1 Background and History

OU1 is located within the City of Kalamazoo, Michigan, and is defined as the areas between Cork Street and Alcott Street where contamination from paper operations is located. OU1 includes areas that are zoned for residential, commercial, and manufacturing uses (Figure 1-2). Cork Street forms the southern boundary, and Alcott Street runs along the northern boundary. Residential development exists along a portion of the eastern side, and a railroad corridor forms a portion of the western boundary. Commercial and manufacturing properties are located north and south of OU1 and along portions of the eastern and western sides of the property.

The Monarch Mill was built by the Kalamazoo Paper Company in 1875. The Bryant Mills (A, B, C, D, and E) were built by the Bryant Paper Company in 1895 and produced a variety of high-quality paper products for the next 94 years.

In large part, PCBs were introduced to OU1 through the recycling of carbonless copy paper that contained PCBs as a carrier for the ink. Carbonless copy paper contained PCBs between 1957 and 1971 (USEPA 1977), and PCBs remained in the recycle stream after that period as the carbonless copy paper supply was depleted. The key risk management goals established for OU1 are associated primarily with exposure to PCBs in the various media.

When mills recycled waste paper that included carbonless copy paper, PCBs were present in the wastewater produced from the recycling process. Typically, the wastewater contained large quantities of suspended particles—primarily cellulose and clay. These solid components of the recycling process adsorb or contain high concentrations of PCBs. PCBs were present in the recycling process from at least 1957 until well after production of carbonless copy paper containing PCBs stopped in the 1970s. In the 1950s, mills began building clarifiers and dewatering or settling lagoons to remove most of the particles, and the clarified wastewater was discharged to rivers and creeks (in this case, Portage Creek). At OU1, the legacy of this practice is PCB-containing materials in the Bryant Historic Residuals Dewatering Lagoons (HRDLs) and Former Residuals Dewatering Lagoons (FRDLs), the Monarch HRDL, and the Former Bryant Mill Pond. The PCB-containing materials, referred to in this report as residuals, have been the focus of the investigations conducted at OU1 (MDEQ 2008).

The Alcott Street Dam was built in 1895 to provide hydroelectric power and to process water for the Bryant Paper Mills. The dam also impounded Portage Creek to form the Bryant Mill Pond as described in the RI report (MDEQ 2008). In 1976, Allied Paper Company obtained a permit (No. 75-12-187) from the Michigan Department of Natural Resources to draw down the reservoir in an effort to reduce contamination impacts through discharge of sediment or groundwater to Portage Creek. Surface water in Portage Creek was lowered 13 feet during the drawdown and exposed sediments that had accumulated over the many years of mill operations. The dam is currently owned by Lyondell Trust, created as a result of the bankruptcy of Millennium Holdings, LLC (MHLLC), and is classified as a high-hazard structure (ARCADIS BBL 2006). The gates have been permanently removed, and the dam was last inspected by MHLLC in May 2006.

1.2 Subareas

OU1 consists of the following areas and subareas based on historical operations, as depicted in Figure 1-2 and described in detail in the RI report:

- **Former Operational Areas**—Consists of Bryant HRDLs and FRDLs, Monarch HRDL (including the Former Raceway Channel), Former Type III Landfill, the Western Disposal Area and adjacent Panelyte Marsh, the Conrail Railroad Property, and the State of Michigan's Cork Street Property.

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BJR: Waste from Western Disposal has encroached onto Conrail, similar to Panelyte Property. Conrail and Panelyte Properties are included only to the extent of the pullback.

- **Former Bryant Mill Pond Area**—Includes the area within the boundary of the Former Bryant Mill Pond, defined by a historical impoundment elevation of 790 feet above mean sea level (amsl). A portion of the Bryant Mill property south of Alcott Street is included within the area.

- ~~Residential~~ ~~**Residentia**~~Residential Properties (Outlying)~~, and Commercial Properties—Divided into the following subareas:~~ —Residential ~~Areas~~Properties that are part of the Site but are not contiguous with the Former Operational Areas include: Clay Seam Area, ~~Former Filter Plant,~~ East Bank ~~Area, four~~Area, four adjacent residential properties (Golden Age Retirement Community and three single-family residences), ~~three~~

~~commercial properties (Goodwill, Consumers Power, Lyondell Trust [formerly MHLLC] south of Alcott Street),~~ and property owned by Lyondell Trust (formerly MHLLC) but used by owners of the three single-family residences (MDEQ 2008). ~~The areas are referred to in this report collectively as the Outlying Areas (separate and not contiguous with the onsite Former Operational Areas).~~

- Commercial Properties (Outlying) — Commercial properties that are part of the Site but are not contiguous with the Former Operational Areas include the three commercial properties (Goodwill, ~~and~~ Consumers Power and Alcott Street Parking Lot [owned by Lyondell Trust, formerly MHLLC] south of Alcott Street)
- ~~Former Bryant Mill Property now owned by the Lyondell Trust [formerly MHLLC] property south of Alcott Street),~~

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1.3 Prior Response Actions

OU1 was designated as a distinct OU within the Site, in part, so cleanup activities could proceed on a separate schedule relative to the remedial activities developed for the Site as a whole. Between 1998 and 2004, a series of actions were completed to minimize exposure potential by consolidating and capping a portion of the PCB-containing materials at OU1. The primary actions performed to date are summarized in the following subsections.

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1.3.1 Time-critical Removal Action at the Former Bryant Mill Pond

In 1998 and 1999, USEPA completed a time-critical removal action (TCRA) at the Former Bryant Mill Pond. The work involved the excavation of 146,000 cubic yards (yd^3) of PCB-containing sediments, residuals, and soils and placement of the materials into the Bryant HRDLs and FRDLs. The excavation was performed in segments by using stream diversions to expose the sediment and excavate in dry conditions. After excavation, confirmation samples were collected, and the area was subsequently backfilled and stream diversions removed (Weston 2000).

The initial excavation was performed with a PCB concentration action level of 10 milligrams per kilogram (mg/kg), and a goal of achieving post-excavation PCB concentrations less than or equal to 1 mg/kg. At locations where initial post-excavation PCB sampling results exceeded this goal, an additional 6 inches of material was removed and another post-excavation sample was collected at the final extent. USEPA then backfilled the excavated area with an amount of clean fill approximately equal to the volume of materials removed. The thickness of the backfill layer ranged from approximately 1 foot at the upstream end of the Former Bryant Mill Pond to approximately 10 feet near the Alcott Street Dam. The surface of the materials placed in the Bryant Mill Pond was graded, seeded, and revegetated with native grasses and plants, and the habitat was restored (Weston 2000).

The post-excavation samples collected from the final excavation were equal to or below the target PCB concentration of 1 mg/kg established for the TCRA in 435 of the 440 samples. The PCB concentration in the remaining five samples ranged from 1.8 mg/kg to 3.8 mg/kg. A total of 410 of the 440 final post-excavation samples were below the 0.33 mg/kg screening-level criterion protective of people eating fish (Weston 2000) recommended by MDEQ in the RI report (MDEQ 2008).

PCBs were the driver for removal at the Bryant Mill Pond. Confirmation samples were not collected for other PCOCs that were identified in the RI. However, the RI identified that it is expected that PCOCs are collocated with the PCB residuals, and addressing PCB contamination is expected to address other PCOCs found at OU1. In addition, excavated areas were backfilled with 1 to 10 feet of clean fill and restored with native vegetation, thereby reducing the risk of direct dermal contact and erosion to Portage Creek in the excavated areas. The completeness of the TCRA is evaluated in development of the remedial alternatives and consideration of institutional controls as discussed in Section 4. ~~A common element of the alternatives includes However, other than institutional controls (ICs) to prohibit ??? at Bryant Mill Pond. , however~~ However, the alternatives do not include additional excavation for the Bryant Mill Pond where removal activities occurred below 790 feet amsl.

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BR: Too early to discuss common elements of alternatives. Have not been developed yet

1.3.2 Interim Response Measures

Beginning in the early to middle 1990s, MHLLC conducted a series of small-scale Interim Response Measure (IRM) activities to restrict access to OU1 and to provide erosion control and stabilization in certain areas. MHLLC also removed remnant structures, such as the Filter Plant, from the historical mill operational areas. The former Bryant Clarifier remains in place. The various components of the IRM are described in the following subsections.

1.3.2.1 Bryant HRDLs and FRDLs

After completion of the Bryant Mill Pond TCRA, MHLLC carried out IRM activities to stabilize the area where USEPA disposed of the materials excavated from the Former Bryant Mill Pond and to further mitigate the exposure to or transport of PCBs at OU1. The IRM completed at the Bryant HRDLs/FRDLs is summarized briefly as follows and described in detail in the RI report (MDEQ 2008):

- Installation of sealed-joint sheet pile along the Bryant HRDLs and FRDLs adjacent to Portage Creek to stabilize the perimeter berms that separate the materials in the Bryant HRDLs and FRDLs from the Portage Creek floodplain (Figure 1-2). The response action was completed in 2001.
- Removal of several hundred cubic yards of soil containing residuals from locations between the sheet pile wall and Portage Creek and consolidation into the Bryant HRDLs and FRDLs. The material was removed in 2000 and 2003 to minimize the potential for PCB releases to Portage Creek.
- Construction of an engineered composite cap for the Bryant HRDLs and FRDLs with its design based on Michigan Act 451 Part 115, solid waste regulations. The cap, which covers the Bryant HRDLs and FRDLs, was constructed between 2000 and 2004.
- Installation and operation of a groundwater extraction system inside the sheet pile wall and beneath the cap (Figure 1-3). The purpose of the system was to mitigate groundwater mounding behind the sheet pile, which might compromise the cap or inundate otherwise unsaturated residuals and increase the potential for migration of PCBs to the creek.

The cap was installed to act as a barrier to minimize the potential for direct contact and reduce infiltration of rainwater. MDEQ expressed concern that the flexible-membrane liner (FML) was left exposed for substantial periods of time and was degraded by exposure to sunlight and punctures from wildlife. MHLLC subsequently repaired the cap, rather than replaced as recommended to address MDEQ concerns. MDEQ remains concerned due to the number and quality of the repairs (MDEQ 2008).

1.3.2.2 Portage Creek Floodplain

In 2002, MHLLC conducted an IRM to remove approximately 1,700 yd^3 of soils and sediments containing residuals located in the floodplain on the eastern side of Portage Creek (referred to as the East Bank Area—Figure 1-2) and PCB-containing soils between the sheet pile and the creek. The materials were consolidated into the Bryant FRDLs prior to construction of the landfill cap. The IRM methods and cleanup targets were similar to those used by USEPA during the TCRA. Results of all post-excavation confirmation samples were below the target PCB removal criterion of 1 mg/kg, and the excavation was backfilled with a minimum of 1 foot of clean fill. The area was subsequently seeded and revegetated with native plants to restore the existing habitat (MDEQ 2008).

Where the IRM actions were taken, materials exceeding 1 mg/kg were removed and were verified by confirmation sampling. PCB concentrations above 1 mg/kg exist in areas of the floodplain where the IRM was not performed, specifically the seep areas. The areas will be considered for action in this FS.

1.3.2.3 Filter Plant

The Filter Plant is a commercial property encircled by the Panelyte Property (Figure 1-2). The Filter Plant was demolished in 2006 by MHLLC. Work done in this area was not observed by the Agencies. As a result, one of the common elements of the Alternatives includes evaluation of the area in the remedial design (RD) to verify cleanup levels were met.

1.4 Remedial Investigation

Early investigative efforts recognized that if the full extent of PCBs were identified and appropriately remediated, then other associated substances at OU1 would be appropriately addressed. The RI therefore focused on PCBs for identifying the extent of contamination (MDEQ 2008). In addition to PCBs, several inorganics, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) were detected in soils, sediments, and groundwater. The following summarizes the RI report conclusions:

- The actions taken at OU1 have caused substantial changes to the distribution of contamination and the topography such that some of the data collected in the early phases of the RI no longer describe current conditions. Although some earlier-collected data have been excluded, a considerable body of information is available that is sufficient to complete the FS, assess the present state of the OU, and inform decisions on future remedial actions.
- Target analyte list (TAL) inorganic constituents in soils and sediments appear to be associated with the PCBs identified at OU1.
- Soils with inorganic impacts may be acting as a source resulting in low-level impacts to the groundwater.
- Target compound list (TCL) VOCs in soils, sediments and groundwater do not appear to be associated with contaminant impact identified at OU1. TCL VOC exceedances in soil and sediment were limited to 1 subsurface soil sample in the Monarch HRDL. The VOC groundwater detections in the most recent sampling event were all below screening criteria.
- TCL SVOCs in soils and sediments appear to have a similar distribution to the contaminant impact based on the data set available.
- The SVOC groundwater impact appears to be much less extensive than the SVOCs in soil at OU1. There were no SVOC exceedances of the screening criteria in the most recent sampling event.
- Concentrations of TCL pesticides did not exceed screening criteria. Pentachlorophenol was detected above screening criteria and is discussed in this report as an SVOC because of its inclusion in the TCL SVOC analyte list.
- TCL pesticides were not present in the groundwater at the time of sampling, which is consistent with the soil and sediment data. One pesticide was detected in a leachate sample below screening criteria, but no exceedances were identified.
- Soils with visual indicators of residual impact can be expected to have PCB concentrations similar to those identified in the Bryant Mill Pond.
- During the most recent sampling, PCBs were detected in several of the groundwater seep monitoring wells located along Portage Creek near the Former Operational Areas, with PCB detections above the groundwater surface water interface (GSI) screening criteria in two locations.

The data presented in the RI report for air, surface water, and biota are not summarized in this FS report because they are secondary exposure pathways that result from contamination in residuals, soils, sediments, and groundwater. The evaluation of media and potential exposure pathways at OU1 are discussed further in Section 1.6.

The RI report describes the data collected between 1991 and 2003. The completion of the prior response actions described in Section 1.3 resulted in significant changes in the lateral extent, mobility, and potential exposure pathways at OU1. Summaries of the data included in the RI report regarding the nature and extent of PCBs at OU1 that can be used to describe current conditions, and the key mechanisms of PCB fate and transport are presented in the following subsection. The data in the RI report, which have been augmented by data from the supplemental groundwater investigation report (Appendix A), have been considered in the development and analysis of alternatives presented in this FS report.

1.5 Nature and Extent of Contamination

PCBs are being used as the primary indicator to define the extent of contamination because PCBs are associated with the residuals, entered the waste stream during the recycling of carbonless paper, and because of their frequency of detection. As identified in the RI report, most other PCOCs (inorganics and SVOCs) appear to be collocated with PCBs in the various media.

PCBs are present in the residuals, some of which have eroded and mixed with the soils and/or sediments near or at the ground surface, in certain subareas of OU1, including the Monarch HRDL and Western disposal area, for example. In other areas they are present only beneath buildings, pavement, and/or clean soil or fill materials that serve as barriers to exposure and transport. Examples of the latter include the Alcott Street Parking Area, portions of the Goodwill property, and the private residential properties, where the available data indicate there is approximately 4 feet or more of clean fill on top of the residuals (MDEQ 2008). Figure 1-4 provides the aerial extent of PCB-containing surface soils and residuals as identified in the RI report. Figure 1-5 provides the aerial extent of PCB-containing soils and residuals.

The extent of PCBs has not been confirmed on parcels owned by Consumers Power, the Golden Age Retirement Community, and certain single-family residential parcels. However, soil borings from adjacent properties had visual and/or analytical confirmation of PCBs, and it was conservatively assumed that PCBs are present. A common element of the alternatives (except no action) is additional surface and subsurface soil investigations during the remedial design to either confirm the absence of PCBs or delineate the extent of PCB-containing soils/residuals.

1.5.1 PCBs

Samples are identified as soil, sediment or residuals based upon the dominant component or characteristic visually identified during sample collection. Residuals refer to the grey clay and fibrous wood material, which is a waste byproduct from former paper recycling operations. Soils are nonresidual material that is largely native, and sediments are inundated soils. Samples composed primarily of residual material as opposed to soils and sediments are referred to as residuals. When soils or sediments are the primary components of a residual containing mixture, the samples are referred to as soil or sediment respectively.

PCBs were detected at concentrations exceeding screening criteria in the following areas: in soils and sediments in the Former Operations Area, Former Bryant Mill Pond, and Residential/Commercial Areas; in groundwater in the Western Disposal Area and Bryant HRDLs/FRDLs; and in seeps in the Former Type III Landfill Area adjacent to the Bryant HRDLs/FRDLs. ~~Locations where~~ PCBs ~~were detected~~ exceedances~~ing criteria~~ in groundwater and seeps were all locations collocated within or immediately adjacent to areas where soils, sediment, or residuals with PCB concentrations exceeding screening criteria were present. The locations suggest~~ing~~ the material is acting as a source to groundwater without significant transport away from the material. Figure 1-6 summarizes the samples collected and shows the range of results for samples analyzed for total PCBs in soils, sediments, and residuals.

Commented [GU7]: Seen sporatically in these wells. PCBs not a source to GW exiting the site.

BJR: See proposed revisions

Commented [JC8]: Material is acting as a source to groundwater

BJR: See proposed revisions

The 66 samples with the highest concentrations of PCBs, those greater than 10 mg/kg, were identified as containing residual material, even if they were labeled as "soil" or "sediment," with the exception of FLF-1, which had a concentration of 85 mg/kg at the 0- to 0.5-foot interval. Although the boring log did not indicate the presence of residual material in the 0- to 0.5-foot interval of boring FLF-1, residuals were the primary component of the 0.5- to 7.0-foot interval immediately below, and may have been present within the interval sampled. There were an additional 46 residual samples analyzed with PCB concentrations less than 10 mg/kg. Residuals that were visually identified but did not have subsequent analytical testing may have high PCB concentrations, but are not represented in Figure 1-6.

FIGURE 1-6

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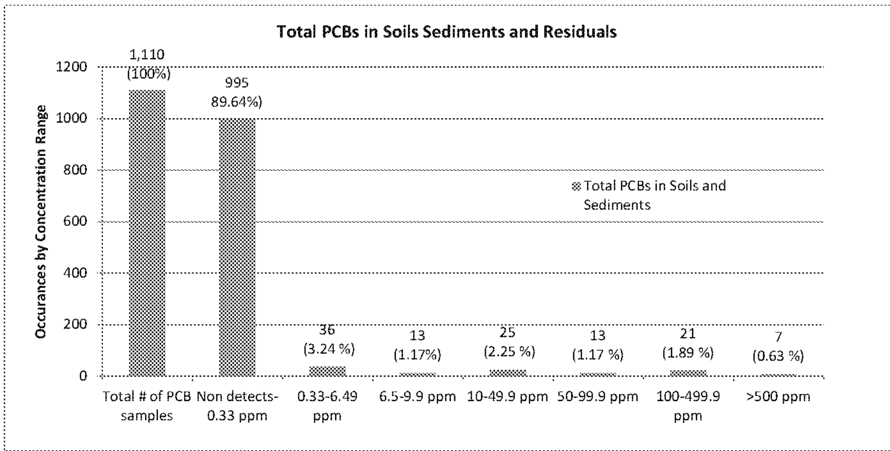

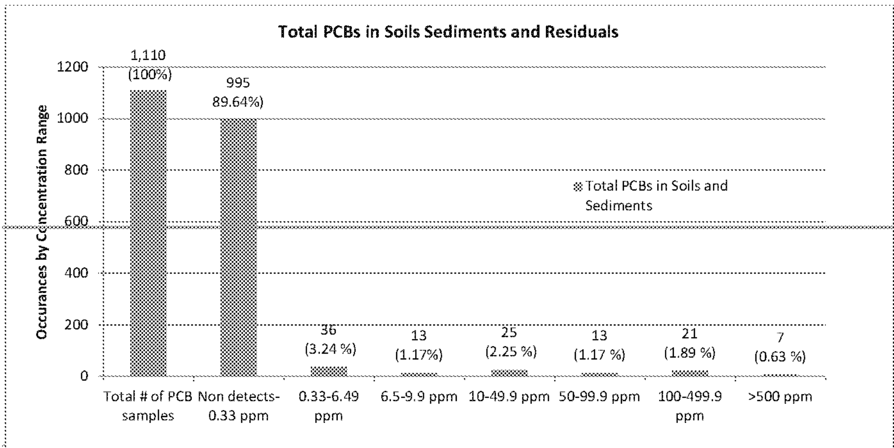

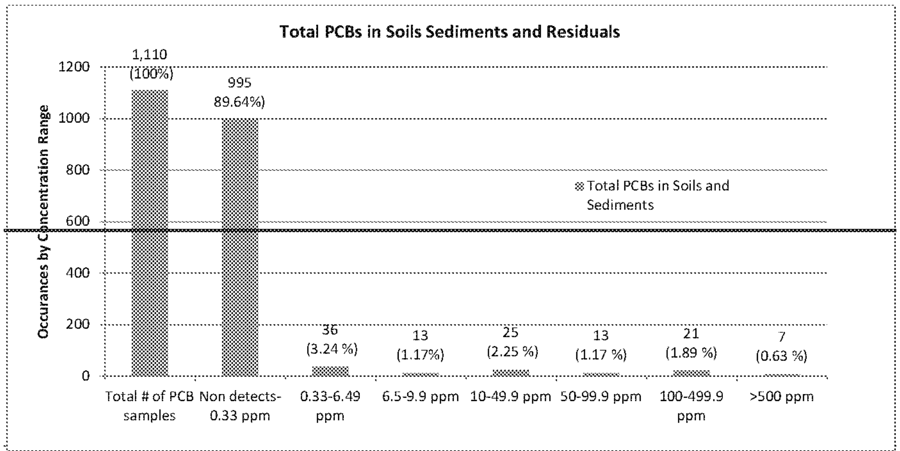

The highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures is referred to as the reasonable maximum exposure (RME) (USEPA 1989). The RME for the site soils and sediments is 60 mg/kg. The RME was calculated as the upper 95 percent confidence limit of the mean concentration in soil, sediment, and residual samples with PCB detections. In performing the calculation, nondetect samples were excluded.

The RI figures were used to evaluate the extent of contamination in soils and sediments requiring remediation at OU1. Figures 4-2A, 4-2B, 4-3A, 4-3B, and summary Tables 4-2A, 4-2C, 4-3A, and 4-3C of the RI report provide PCB screening criteria exceedances in surface soil, subsurface soil, and sediment and are provided in Appendix D.

The Bryant Mill Pond TCRA was performed to remove PCB impacts above the anticipated final remedy criteria for OU1. As summarized in Section 1.3.1, most samples were equal to or below the target PCB concentration of 1 mg/kg. Through excavation and backfill, the Bryant Mill Pond TCRA reduced the extent of the PCB impacts above 1 mg/kg and capped any remaining exceedances (maximum concentration of 3.8 mg/kg) minimizing potential exposure. Generally, no additional remedial actions are being considered for the previously excavated areas within the Former Bryant Mill Pond Area with the exception of the seep areas along the Former Type III Landfill.

The response activities removed or consolidated contaminated material into the capped HRDLs and FRDLs. These actions would minimize the potential for transport to the groundwater and the resulting groundwater impacts. The most recent (2002–2003) groundwater sampling activity results were used in the RI to represent conditions at OU1 after completion of the removal activities. Because the wells included in the sampling events differ between 2002 and 2003, the nature and extent of PCB contamination in groundwater cannot be drawn from either event on its own. For this reason, the 2002 and 2003 data sets should be considered collectively for the most accurate depiction of current groundwater conditions (MDEQ 2008). Older groundwater sampling results are not included because they no longer represent current conditions at OU1. As mentioned in Section 1.4, the data collected before 2002/2003 represent somewhat different site conditions. Much of the earlier data are groundwater samples collected within the Bryant Mill Pond, before highly contaminated material was removed and then consolidated and capped above the water table within the HRDL and FRDL as a part of the TCRA and the IRM.

PCBs were detected at concentrations above the screening levels established in the RI from 3 of 56 monitoring well locations and 2 of 20 seep locations (Appendix D, RI Tables 4-4A and 4-4G, Figures 4-4A and 4-4B). The groundwater and seep locations are within or adjacent to soil sampling locations where PCBs exceed screening levels. The areas are included in the areas to be considered during the development of the potential alternatives for OU1.

The three groundwater sampling locations at which the PRG for PCBs in groundwater was exceeded are MW-8A and FW-101 in the Western Disposal Area, and MW-122AR in the Bryant HRDLs/FRDLs Area. MW-122AR is within the sheet pile wall that was installed as part of the IRM activities. MW-8A and FW-101 are located in the southeast corner of OU1 in areas where soils exceed the PCB screening levels.

The two seep locations in which the groundwater screening level for PCBs was exceeded are SP-G and SP-H in the Former Type III Landfill. The seeps are located a few feet from each other, where residuals remain. As described in Section 1.3.2.2, an IRM was performed in 2002 where residuals in the East Bank Area and PCB-containing soils between the sheet pile and the creek were excavated and consolidated into the Bryant FRDLs prior to construction of the existing landfill cap. Results of all post-excavation confirmation samples were below the target PCB removal criterion of 1 mg/kg. ~~A common element of the Alternatives includes nonen~~ ~~o~~No additional remedial actions ~~are planned~~ are planned for the East Bank or floodplain areas that were excavated and covered during IRM actions along Portage Creek, with the exception of areas where seeps have been observed.

Although the Bryant HRDLs and FRDLs cap acts as a barrier to minimize the potential for direct contact, the integrity of the FML may have been compromised and may not be fully mitigating the infiltration of precipitation. Infiltrating precipitation could form leachate and result in groundwater impacts. As a result, HRDL and FRDL areas are included in the alternatives to be evaluated.

Residuals from the Filter Plant were excavated and disposed of in the Western Disposal Area. As described in Section 1.3.2.3, work done in this area was not observed by the Agencies, and as a result, a common element of the alternatives includes evaluation of this area during the RD to verify cleanup levels were met.

Commented [JC9]: Since the FS is not the final decision document – will need to include this in the common elements of Alternatives and identify in the ROD.

BR: Will include in common elements, but too early to discuss as "common elements" here since they have not yet been developed.

Commented [GU10]: I see your point. Currently stated sounds like we have already selected a remedy

BJR: Will revise

1.5.2 VOCs, SVOCs, Pesticides, and Inorganic Constituents

PCBs are the primary PCOC for OU1. However, SVOCs, and inorganic constituents also exceed screening levels in various media onsite and are considered as PCOCs for OU1. VOCs soils and sediment exceedances were limited to one subsurface soil sample within the Monarch HRDL. One VOC groundwater exceedance occurred in 1993, but no exceedances were identified in the most recent sampling event. SVOCs exceedances of screening levels in soils, sediments, and groundwater are generally collocated with PCBs in the same media. Inorganic constituents in soils, sediments, and seeps are also collocated with PCB exceedances of screening levels. Inorganic exceedances of screening levels in groundwater generally occur within areas where PCBs exceed soil screening levels, with the exception of the area along Portage Creek within the area the Former Bryant Mill Pond IRM. By addressing the PCB exceedances with the potential alternatives for OU1, the exceedances of VOCs, SVOCs, and inorganic constituents will also be addressed.

Tables 4-2E, 4-2G, 4-3E, 4-3G, 4-4C, and 4-4I of the RI report summarize the exceedances of VOCs, SVOCs, pesticides and inorganics in soils, sediments, groundwater, and seeps (Appendix D). Figures 4-2D, 4-2E, 4-2F, 4-3C, 4-3D, 4-3E, 4-4C, 4-4D, and 4-4J of the RI report present the information summarized in the tables (Appendix D).

1.6 Fate and Transport

In the final RI report, MDEQ identified the following PCB fate and transport mechanisms at OU1:

- PCB transport from surface water runoff and soil erosion
- PCB transport in groundwater
- PCB transport in Portage Creek
- PCB transport in air

The key exposure pathway of concern is the consumption of PCB-containing fish. As a result, the potential for bioaccumulation of PCBs from sediment into fish/biota tissue is of primary concern. The fate and transport mechanisms are briefly summarized below with the relevance of each mechanism to the development of the FS. The PCB fate and transport mechanisms are associated with secondary exposure pathways from contamination in residuals, soils, sediments, and groundwater. The remedial alternatives will be focused on addressing the source contamination.

1.6.1 PCBs in Residuals

In general, PCBs are chemically and thermally stable (Amend and Lederman 1992), fairly inert, have low solubility in water, and have a high affinity for solids making them strongly adhere to residuals. Typically, the lower the water solubility of a chemical, the more likely it is to be adsorbed onto solids. The degree of adsorption of PCBs in soils is a function of the soil organic content and the adsorption properties of the specific PCB compounds that are present. Other than organic content, soil or sediment characteristics that affect the mobility of PCBs include soil density, particle size distribution, moisture content, and permeability. Meteorological and physical conditions such as amount of precipitation and the presence of organic colloids (micron-sized particles) can also affect the mobility of PCBs in the environment (USEPA 1990). PCBs that are dissolved or sorbed to mobile particulates (for example, colloids) may also migrate with groundwater in sediments and soils.

The degree of adsorption of PCBs in soils is a function of the soil organic content and the adsorption properties of the specific PCB compounds that are present. Adsorption properties are generally characterized by an organic carbon partitioning coefficient denoted by Koc. The Koc values for PCBs are relatively high (Chou and Griffin 1986), which means that PCBs readily adsorb to organic material in media such as sediments and soils. The octanol water partitioning coefficient, Kow, is a measure of PCB's solubility in water. The coefficient is the ratio of the concentration of PCBs in octanol over the concentration of PCBs in water. PCBs tend to have high Kow indicating they are not very soluble in water. Taken together, the combination of low-water solubility and high Kow values indicates that PCBs have a strong affinity for soils and suspended solids, especially those high in total organic carbon (Chou and Griffin 1986).

The residuals present at OU1 are composed primarily of fibrous wood material and clay. PCBs have a high affinity for the residuals due to the high organic content. When compacted, the residuals have a low hydraulic conductivity. The hydraulic conductivity of 10 residuals samples collected from OU1 was approximately 1.3×10^{-7} centimeters per second (MDEQ 2008).

Based on the combined effects of high affinity for PCBs to adhere to the residual and the low hydraulic conductivity, it is understood that PCBs do not migrate significantly from the residual material. This finding is supported by the lesser extent of PCB detections in groundwater samples, approximately 13 percent, than in soil or sediment where PCBs are bound to the residual material.

1.6.2 Groundwater

The groundwater and seep samples collected during the 2002–2003 comprehensive sampling activity represent the most current data available to evaluate groundwater conditions. PCB detections associated with the 2002–2003 sampling include seeps and monitoring wells in areas that are located in the immediate vicinity of or in direct contact with PCB-containing residuals. Assessing the potential impact of PCB-containing residual to groundwater was a consideration in the development of potential remedial alternatives. PCBs were detected in only 13 percent of the 133, 2002/2003 groundwater samples collected. The 6 exceedances of GSI groundwater criteria occurred in wells screened within or immediately adjacent to the residuals. The 2002-2003 sampling of wells near Portage Creek indicate that groundwater was not exceeding the GSI criteria prior to discharge to Portage Creek. This finding supports the assumption that PCB transport in groundwater is limited. Alternatives have been developed that minimize contact of groundwater with PCBs in soils and residuals. ~~Also the GSI criteria for Portage Creek is a Site PRG for groundwater, and the Alternatives have been developed to meet this PRG.~~

Commented [GU11]: We are good with that statement, right?

Commented [GU12]: Should be fine. Let's just check wording

BJR: Have not yet identified the PRGs in this document. Recommend deleting the last sentence.

1.6.3 Surface Water Runoff and Soil Erosion

There are portions of OU1 (primarily in the Former Operational Areas) where PCBs and other PCOCs are present in surface soils and residuals. The materials may be transported to the floodplain or sediments in Portage Creek by erosion through the air or surface water runoff. Alternatives that prevent direct exposure of PCB-containing soils and residuals to air or surface runoff have been developed.

1.6.4 Direct Discharge

As described in the RI report, the most significant historical source of PCBs to Portage Creek from OU1 was the discharge of PCB-containing residuals at the Former Bryant Mill Pond (RI Section 5.5; MDEQ 2008). The excavation of PCB-containing sediments, residuals, and soils and subsequent replacement with clean fill in the Former Bryant Mill Pond has isolated the materials from direct contact with surface water, and removed the largest source of PCBs to Portage Creek at OU1. Under current conditions, the remaining potential sources of PCBs to Portage Creek from OU1 are primarily associated with the erosion of contaminated soils and sediments. The pathways are addressed in the development of remedial alternatives.

1.7 Supplemental Groundwater Study

In 2009, MHLLC completed a groundwater assessment to evaluate the potential for impacted groundwater at OU1 to migrate to the City's drinking water wells (ARCADIS 2009a). The first phase of the Supplemental Groundwater Study included an evaluation of existing data from OU1 and the nearby Strebor facility, and review of a groundwater flow model developed by the City (City of Kalamazoo 1999) to preliminarily evaluate the likelihood of a complete migration pathway from OU1 to the City's Central Wellfield. The assessment of existing data suggested that such a groundwater migration pathway to the City's Central Wellfield is unlikely. The assessment is based on the presence of a lateral aquitard beneath portions of OU1 and an upward vertical hydraulic gradient between the regional aquifer (used by the City for potable purposes) and the shallow aquifer.

The second phase of the study included the measurement and analysis of groundwater elevations obtained from wells located on OU1 and the Strebor, Panelyte, and Performance Paper properties to more quantitatively evaluate groundwater flow from OU1 offsite. The groundwater elevation data supported the conceptual understanding of the following:

- There is an upward gradient from the lower regional aquifer upward toward the surficial aquifer.
- Shallow groundwater flow from adjacent properties to the east and west is directed onto OU1.
- Portage Creek is the point of discharge for shallow groundwater from OU1.
- A flow path from OU1 toward the City's Central Wellfield is unlikely.

Further empirical support for the conceptual understanding was provided by the analytical results for water samples collected by the City from its own production wells. There have been no detections of PCBs in the City's samples, even at trace levels.

The results of the supplemental groundwater investigation report provide a reasonable basis to determine that it does not appear there is a groundwater migration pathway from OU1 to the City's Central Wellfield. The complete report is included as Appendix A.

In a letter from MDEQ to USEPA on April 16, 2010, MDEQ stated that, in general, the MDEQ concurs with the following conclusions:

- Portage Creek appears to be the primary influence on the configuration of the water table surface within OU1. In the main disposal area of OU1, shallow groundwater discharges radially to Portage Creek.
- Shallow groundwater is influenced, although not completely captured, by the creek.
- Due to the upward pressure exerted by the groundwater present in the regional aquifer, the downward flow of groundwater from the surficial aquifer monitored at OU1 to the deeper regional aquifer is highly improbable.

Various data (collected over time) illustrate hydraulic disconnection between the surficial aquifer unit and the regional aquifer unit.

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1.8 2011 Waste Characterization Sampling

Upon review of the RI sample results, it was determined that ~~it was appropriate to test~~ concentrations in residuals, soils, and sediments for lead, mercury, and chromium ~~could exceed~~ ~~using the~~ were of a level that could potentially exceed toxicity characteristic leaching procedure (TCLP) concentrations for characteristically hazardous waste. As a result, in July 2011, 8 samples were collected from locations with the highest historic concentrations of each analyte. The TCLP was run on each of the samples. None of the TCLP sample results exceeded the concentration for the material to be considered a characteristically hazardous waste (USEPA 2011).

1.9 Identification of Potential Contaminants of Concern

The RI report included a comparison of all detected concentrations of VOCs, SVOCs, pesticides, PCBs, and inorganics in residuals, soil, groundwater, groundwater seeps, sediments, and surface water to Act 451, Part 201, screening criteria. The screening criteria are conservative, risk-based values developed by MDEQ using generic exposure factors and scenarios. The outcome of the comparison against screening criteria was that PCBs, SVOCs, and inorganics were classified as PCOCs within soil/sediment at OU1, and PCBs and inorganic constituents were identified as PCOCs in groundwater. A comparison of PCOCs to chemical-specific ARARs is presented in Section 2. The comparison in Section 2 is used to develop the final list of COCs to be evaluated at OU1.

Tabular summaries of the screening evaluations for samples of soils, sediments, groundwater, and seeps at OU1 are presented in Appendix D. The locations where sample analytical results are above the screening criteria are summarized graphically in a series of figures in Appendix D.

1.9.1 PCBs

The investigation and cleanup work at OU1 over the past decade has been driven by the presence of PCBs and focused on mitigating potential risks posed by PCBs. For the purposes of the FS analyses, PCBs are PCOCs in soils, sediment, groundwater, and residuals. As described in Section 1.1 of the RI report, constituents other than PCBs have been detected in various media and are generally collocated with the PCBs. By remediating the PCBs, the exceedances of screening levels by other constituents are expected to be addressed.

1.9.2 Organic and Inorganic Constituents

Table 1-1 lists organic and inorganic contaminants by media that exceed Michigan Act 451, Part 201, screening criteria, which includes both risk-based and statewide background values in the RI. The contaminants listed are the PCOCs that have been used to define the areas associated with OU1 that require remediation.

The VOCs acetone and carbon tetrachloride were each detected in one sample at a concentration that exceeded the GSI protection screening criterion. Although not flagged, acetone is a common laboratory contaminant. The RI suggested VOCs detected in surface soils and sediments do not appear to be associated with OU1 activities. Based on the data evaluation in the RI report and frequency of detection, VOCs are not identified as PCOCs in any medium due to their infrequent detection above screening criteria.

The SVOC 4-methylphenol is found in several subsurface residuals samples at concentrations exceeding the GSI protection soil criteria. However, 4-methylphenol was not detected in any groundwater sample locations at concentrations exceeding GSI criteria. The SVOC 4-methylphenol is considered a PCOC at OU1 for residuals and soils. Since the distribution of 4-methylphenol is consistent with the distribution of PCBs, it is expected that addressing PCBs in soils, sediments, and residuals will also address the exceedances of 4-methylphenol.

The SVOCs acenaphthene (1 exceedance), carbazol (1 exceedance), naphthalene (2 exceedances), dibenzofuran (1 exceedance), pentachlorophenol (2 exceedances), and phenanthrene (1 exceedance) were detected in soils and residuals; however, due to the limited number of exceedances of the GSI criteria, the analytes may not be related to OU1 activities and are not considered PCOCs.

No exceedances of screening levels for TCL pesticides were noted in any media. Pesticides are not considered PCOCs.

TABLE 1-1

Summary of VOCs, SVOCs, Pesticides, PCDD/PCDF, and Inorganic Exceedances

OU1 Feasibility Study Report—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Analyte	Surface Soils	Subsurface Soils	Surface Sediments	Subsurface Sediments	Groundwater[a]	Seeps[a]
VOCs						
Carbon Tetrachloride		1/54				
Acetone			1/2			
SVOCs						
Acenaphthene			1/2			
Carbazole			1/2			
Dibenzofuran			1/2			
Phenanthrene		1/54				
4-methylphenol		12/54				
Naphthalene		1/54	1/2			
Pentachlorophenol		1/54	1/2			
Pesticides						
None						
PCDD/PCDF[b]						
Total TCDD Equivalent	1/8					
Inorganics						
Aluminum	1/2	26/55			5/72	1/37
Antimony		7/55				
Arsenic	1/2	9/54	1/2		23/72	10/37
Barium		23/55	1/2	1/1	4/72	4/37
Cadmium		5/55				
Chromium	2/2	53/55	2/2	1/1	1/72	
Cobalt		6/55				
Copper		23/55		1/1		
Cyanide		21/54			4/72	3/37
Iron	1/2	8/55	1/2	1/1	64/72	31/37
Lead	1/2	20/55	1/2	1/1	1/72	
Magnesium		13/55				
Manganese		4/55			66/72	36/37
Mercury		20/55		1/1		
Nickel		1/55		1/1	4/72	1/37
Selenium		10/55	1/2	1/1		

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TABLE 1-1
Summary of VOCs, SVOCs, Pesticides, PCDD/PCDF, and Inorganic Exceedances
OU1 Feasibility Study Report—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Analyte	Surface Soils	Subsurface Soils	Surface Sediments	Subsurface Sediments	Groundwater[a]	Seeps[a]
Silver				1/1	2/72	
Sodium					4/72	
Vanadium					1/72	1/37
Zinc		28/45	1/2	1/1	7/72	

Note:
x/y = number of samples (x) exceeding screening level criteria out of number of samples (y)
a Only the data from the 2002/2003 groundwater and seep samples are summarized to reflect conditions after removal
b Dioxin and furans only sampled in surface soils in 1998
PCDD = polychlorinated dibenzodioxins, PCDF = polychlorinated dibenzofurans

Polychlorinated dibenzodioxin (PCDD)/polychlorinated dibenzofuran (PCDF) sampling was limited, with ~~eight~~ 8 surface soil samples collected in 1998 from the Former Operational Areas. Of the ~~eight~~ 8samples, ~~one~~ 1 sample exceeded the screening criteria. The screening criteria are the residential direct contact criteria. The sample did not exceed the non-residential direct contact criteria. The sample exceeding screening criteria is located within the Monarch HRDL. PCDD/PCDF are retained as PCOCs at OU1. It is expected that addressing PCBs in soils, sediments, and residuals will also address the exceedance of PCDD/PCDF or other areas where PCDD/PCDF could potentially be collocated with PCB impacts.

Silver (2 exceedances) and vanadium (1 exceedance) were analyzed in 72 groundwater samples. Additionally, silver exceeded the screening level criteria in the one subsurface soil sample analyzed and vanadium exceeded the screening level criteria in ~~one~~ 1 of the 37 seep samples analyzed. With a rate of exceedances less than 5 percent of the samples analyzed and no apparent relationship to the disposal of paper residuals, silver and vanadium are not considered PCOCs at OU1.

The elevated concentrations of zinc detected in certain groundwater samples may be related to well construction materials. Consistent with the findings of the RI report, zinc was detected at concentrations exceeding GSI criteria in samples of groundwater collected exclusively from pre-RI monitoring wells constructed with galvanized steel pipe risers. Conversely, none of the groundwater samples collected from monitoring wells constructed with stainless steel risers contained zinc at concentrations above GSI criteria. A review of the scientific literature indicates that zinc, iron, manganese, and cadmium are typical products of galvanized steel corrosion (Barcelona 1983; USEPA 1992b). However, based on the data screening evaluation, zinc also exceeded screening levels in 28 of 45 subsurface soil samples, and for this reason is retained as a PCOC in all medium.

1.10 Preliminary Remedial Goals

The investigation and cleanup work at OU1 over the past decade has been driven by the presence of PCBs and focused on mitigating the associated potential risks. As described in Section 1.9, SVOCs and inorganic constituents have been detected in various media and are also considered PCOCs for OU1 with PCBs. The PCOCs are generally collocated with the PCBs, so by remediating the PCBs, the exceedances of other PCOCs are expected to be addressed.

In March 2009, a technical memorandum (CH2M HILL 2009) was developed to assist in establishing a series of PCB PRGs for OU1. The PRGs were compiled after considering ongoing sources, release mechanisms, impacted media, potential exposure routes, and potential human and ecological receptors present at OU1. A series of quantitative PRGs and one qualitative PRG included in the March 2009 memorandum. The quantitative values are based on risk-based criteria described in the human health and ecological risk assessments developed for the Site (CDM 2003a and 2003b) and other relevant risk-based regulatory criteria. The quantitative PRGs were developed based on the understanding that PCBs are the primary cause of human health and environmental risks at OU1. The March 2009 memorandum recommends a qualitative criteria, the visual identification of residuals, to assist in the determining if remedial action is required (CH2M HILL 2009).

The March 2009 memorandum includes an assessment of potentially complete exposure pathways and relevant receptors (CH2M HILL 2009). Of the pathways, the drinking water pathway was considered to be incomplete for OU1, since no drinking water wells are present onsite where PCB concentrations exceed criteria. The drinking water pathway is also considered incomplete for offsite receptors, since shallow groundwater primarily discharges to Portage Creek and a flow path toward the City wellfield is unlikely. However, to protect against the future use of groundwater as drinking water, drinking water criteria are included in consideration of PRGs. The PRG memorandum recommends that remedial alternatives include institutional controls to prohibit the installation of drinking water wells on or adjacent to OU1 to prevent the completion of this pathway in the future. Since shallow groundwater primarily discharges to Portage Creek, the GSI criteria ~~for Portage Creek~~ is included as a PRG ~~for groundwater venting to Portage Creek~~. The PRG memorandum is in Appendix B for an initial analysis of criteria. Additional analysis was performed in the development of this FS as presented in ~~; however this FS, including~~ Table 2-3~~, supercede the PRG memorandum in Appendix B . For example, the PRG for residential areas is 1 ppm based on the high occupancy cleanup level under 40 C.F.R. 761. 6 1(a)(4) and not 2.5 ppm as suggested by the March 2009 memorandum. Similarly the ARAR analysis set forth in the FS supercedes the ARAR analysis in the March 2009 memorandum~~.

Where available for contaminants other than PCBs, updated Act 451, Part 201, screening criteria and drinking water maximum contaminant levels will be used in the FS.

1.11 Conceptual Site Model

MDEQ completed a *Site-wide Final (Revised) Human Health Risk Assessment* (CDM 2003a) and *Final (Revised) Baseline Ecological Risk Assessment* (CDM 2003b) for the entire Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. The human health risk assessment quantitatively assessed potential risks to human health through exposure to media impacted with PCBs, including the following:

- Consumption of fish
- Direct contact with contaminated floodplain soils
- Inhalation of dust and volatile emissions from floodplain soils

The baseline ecological risk assessment quantitatively assessed potential risks to various ecological receptors for different exposure pathways. Risk to human and ecological receptors exists at the Site based on the results of the human health risk assessment and baseline ecological risk assessment.

Commented [MB13]: Let's add stronger language that the risks posed by Allied Landfill are to recontamination to Portage Creek and downstream by erosion and run off. Sets us up better for RAOs and it is what we will discuss in upcoming meetings.

BJR: See proposed text revisions

1.11.1 Soils and Sediments

OU1 was identified as a source of PCB contamination to Portage Creek, which flows to the Kalamazoo River. Soils and sediments containing residuals outside the existing cap have the potential for erosion to Portage Creek. During preparation of the RI, MDEQ developed a conceptual site model, which suggested that addressing PCB contamination in soils and sediments would also address PCBs in groundwater and other inorganic and organic contaminants that exceed screening levels.

Out of 60 inorganic sample locations and 59 organic soil, sediment, and residual sample locations, 10 locations had exceedances of GSI criteria for SVOCs and inorganics but did not exceed PCB criteria. The locations include:

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B-7B, DLHB-1, DLHB-2, DLHB-3, MA-1, MA-4, SP486, SP569, WA-3, and WA-5. Of the locations, DLHB-1, DLHB-2, DLHB-3, MA-1, MA-4, SP486, SP569, WA-3, and WA-5 are located within the Former Operations Area and are adjacent to locations where concentrations of PCBs exceeded criteria. Location B-7B is located on the western edge of OU1 in the Residential/Commercial area near the West Access Road. Location B-7B only had inorganics exceedances slightly above the screening criteria which were qualified results and do not appear to be related to OU1 activities.

The TCRA and previous IRMs resulted in the consolidation of materials with elevated PCBs under the cap on the HRDLs and FRDLs. The integrity of the cap is currently uncertain resulting in the potential erosion of the cap and exposure of the underlying PCB-containing materials. These materials could be subject to the same offsite transport mechanisms.

1.11.2 Groundwater

The current evaluation of groundwater monitoring well and seep sampling results for locations that exceed screening levels support the conceptual site model assumption that addressing PCBs in soils and sediments will result in addressing other contaminants in groundwater. Information on the number of exceedances for each analyte is included in Table 1-1.

Monitoring well and seep locations that exceed organic and inorganic screening levels are identified on RI figures included in Appendix D. The locations are within, adjacent to, or downgradient of the Former Operations Area where PCB concentrations exceed screening levels. The results support the conceptual site model assumption that addressing PCBs in soils and sediments will result in addressing other contaminants in groundwater.

The alternatives presented within this FS were developed considering the conceptual site model.

SECTION 2

22 Development of ARARs and Remedial Action Objectives

Section 2 identifies ARARs and RAOs and provides a list of GRAs for OU1.

2.1 Identification and Rationale for ARARs

CERCLA remedial actions must comply with other laws and regulations that are applicable or relevant and appropriate to the selected remedy. Applicable or relevant and appropriate requirements are referred to as ARARs. ARARs are federal and state public health and environmental requirements used to define the extent of site cleanup, identify sensitive land areas or land uses, develop remedial alternatives, and direct site remediation. ARARs are evaluated early in the work planning process so that fieldwork can be designed to collect data needed to satisfy ARAR requirements and, if necessary, to identify and evaluate remedial alternatives relative to ARARs.

Applicable requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site (40 *Code of Federal Regulations* [CFR] § 300.4). Depending on the circumstance, hazardous substance, pollutant or contaminant, a state or federal environmental law or regulation may not be applicable but may be relevant and appropriate. Only the state standards that are identified in a timely manner and are more stringent than federal requirements may be applicable or relevant and appropriate (40 CFR § 300.400[g]). Section 121 of CERCLA requires that remedial alternatives that attain or exceed ARARs be primarily considered. To-be-considered factors are nonpromulgated advisories or guidance issued by the federal or state government that are not legally binding and do not have ARAR status. In many circumstances, such factors will be considered along with ARARs in determining the cleanup level required to protect human health and the environment.

ARARs are grouped into three types: chemical-specific, action-specific, and location-specific. The statutes and regulations listed in Table 2-1 contain requirements deemed to be potential ARARs at OU1 or to-be-considered factors. The ARARs are based on the Preliminary List of Possible ARARs included in the *Multi-Area Feasibility Study Technical Memorandum; Preliminary List of Possible Applicable or Relevant and Appropriate Requirements* (ARARs Tech Memo; ARCADIS 2009b). The most important ARARs are discussed in the following subsections.

2.1.1 Chemical-specific ARARs

Chemical-specific ARARs include laws and requirements that establish health- or risk-based numerical values or methodologies for environmental contaminant concentrations or discharge.

2.1.1.1 Michigan Public Act 451, Part 201—Environmental Remediation

Part 201 establishes generic cleanup criteria for implementation of a remedial action or allows for risk-based determination of site-specific cleanup criteria. Where detection limits or background concentrations are greater than risk-based criteria, the detection limit or background concentration are used instead of the risk-based cleanup criteria. Part 201 also contains action-specific ARARs for OU1. MCL 324.20114c requires land use or resource restrictions, including restrictive covenants, for remedial actions that do not satisfy cleanup criteria for unrestricted residential use. Also MCL 324.20120e requires that a response action demonstrate compliance with groundwater/surface water requirements for groundwater venting to surface water.

2.1.1.2 Michigan Public Act 451, Part 31—Water Resources Protection

2.1.1.3Part 31, Water Resources Protection, of the (NREPA) Natural Resources and Environmental Protection Act establishes state criteria for rivers, creeks, and floodplain areas, to protect aquatic life and human health. It also

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establishes water quality standards and monitoring requirements for discharge effluents, including stormwater and venting groundwater, specifying standards for several water quality parameters, including COCs.

~~2.1.1.4~~2.1.1.3 Clean Water Act Section 304

Under Section 304 of the Clean Water Act, EPA has developed water quality criteria for 1) protection of human health; and 2) protection of aquatic life. See discussion under Michigan Public Act 451 above regarding protection of water quality criteria in Portage Creek.

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2.1.2 Action-specific ARARs

Action-specific ARARs are activity- or technology-based, and they typically control remedial activities such as the generation or disposal of waste.

2.1.2.1 Clean Water Act

Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into waters of the United States, including the creek, floodplain, or wetlands. While CERCLA remedies are exempt from permit requirements, the substantive requirements of the implementing rules apply to the wetlands areas at the Site. If any wetlands are filled, Superfund policy is to require a minimum of one acre of wetlands mitigation for each acre of wetland filled. (See "Considering Wetlands at CERCLA Sites" OSWER 9280.0-03). The Federal Mitigation Rule is set forth at *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* 40 C.F.R. § 230.94(c)(2-14). In addition, the Clean Water Act applies to remediation alternatives, which treat and or discharge water.

2.1.2.2 Toxic Substances Control Act

The principal contaminant of concern is PCBs. Under 40 C.F.R. § 761.50(b)(3), PCB remediation waste is "regulated for cleanup and disposal in accordance with 40 C.F.R. § 761.61." 40 C.F.R. § 761.3 defines PCB remediation waste as "waste containing PCBs as a result of a spill, release, or other unauthorized disposal ... at any concentration from a source not authorized for use under TSCA. PCB remediation waste includes "environmental media containing PCBs, such as soil and gravel, dredged materials, such as sediments, settled sediment fines, and aqueous decantate from sediment." 40 C.F.R. § 761.61(a)(4) defines "bulk PCB remediation waste" to include "soil, sediments, dredged materials, muds, PCB sewage sludge, and industrial sludges." Specifically, TSCA regulations found at 40 C.F.R. § 761.61(c) allows for a risk based method for cleanup or disposal of PCB remediation waste when USEPA finds that that the method of disposal will not pose an unreasonable risk of injury to human health and the environment. ~~The RAOs, developed later in Section 2 will address the risks at the site.~~

Commented [JC14]: The rationale for "unreasonable risk of injury" is n't appropriate here – move to discussion of how alternatives meet the ARAR in Section 4

The TSCA requirements governing onsite disposal of PCB remediation waste are the most stringent landfill design, closure and post closure requirements listed as ARARs for the waste-in-place remedy options presented in this FS Report. 40 C.F.R. § 761.61(b) requires deed restrictions for areas with caps and for areas with PCB levels in soil remaining above high occupancy cleanup levels.

2.1.2.3 Resource Conservation and Recovery Act

RCRA regulations governing the identification, management, treatment, storage, and disposal of hazardous waste are applicable for hazardous waste if it is generated or identified during the remedial action.

Michigan is authorized to implement its RCRA program; therefore, the State laws and regulations arising out of that program constitute the ARARs instead of the Federal authorizing legislation. The State's RCRA requirements apply to any response activities that generate waste material that may be classified as hazardous waste. However, hazardous waste is not present at the site based on existing data. Also, the State's hazardous waste landfilling, closure, and post closure requirements are not applicable for onsite disposal because any material identified during the response action as RCRA hazardous waste will be disposed of offsite. RCRA hazardous waste generator requirements would be applicable if hazardous waste is identified at the site.

2.1.2.4 Michigan Public Act 451, Part 115 – Solid Waste Management

The Part 115 rules promulgated for the cover design, groundwater monitoring, hydrogeologic monitoring and construction quality control requirements for a Type III sanitary landfill would be relevant and appropriate for those alternatives that cap material in place at OU1.

2.1.2.5 River and Harbors Act

Section 10 prohibits the creation of obstructions to the capacity of, or excavation or fill within the limits of, the navigable waters of the United States. Typical requirements of dredging permits include measures to minimize ~~resuspension~~re-suspension of sediments and erosion of sediments and stream banks during excavation.

2.1.3 Location-Specific ARARs

Location-specific ARARs restrict the occurrence of chemicals in certain sensitive environments, such as wetlands.

2.1.3.1 Fish and Wildlife Coordination Act

This statute requires that any action taken involves consideration of the effect that water-related projects would have on fish and wildlife, and that preventative actions are made to prevent loss or damage to the resources.

2.1.3.2 Executive Orders 11988 and 11990, and 50 CFR § 6 Appendix A

Executive Orders (EOs) 11988 (Floodplain Management) and 11990 (Protection of Wetlands) are to-be-considered factors. They set forth USEPA policy for carrying out the provisions of EOs 11988 and 11990. EO 11988 requires that actions be taken to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. EO 11990 requires that actions at the site be conducted in ways that minimize the destruction, loss, or degradation of wetlands.

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2.2 Remedial Action Objectives

RAOs are goals specific to media or OUs for protecting human health and the environment. Risk can be associated with current or potential future exposures. RAOs should be as specific as possible without unnecessarily limiting the range of alternatives to be developed. Objectives aimed at protecting human health and the environment should specify the following: (1) COCs, (2) exposure routes and receptors, and (3) an acceptable contaminant level or range of levels for each exposure route (that is, a PRG) (USEPA 1988).

RAOs were developed for OU1 in part based on the contaminant levels and exposure pathways found to present potentially unacceptable risk to human health as determined during the RI (MDEQ 2008) and in the PRG Memorandum (CH2M HILL 2006). PRGs were then developed based on the potential exposure pathways, risk assessments (CDM 2003a and b) and State ARARs. The RAOs, remediation goals, and remediation strategies, alternatives developed in Section 4 of this report, address unacceptable risks at the site. Table 2-2 presents the RAOs.

TABLE 2-2
Remedial Action Objectives
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

RAO 1	Mitigate the potential for human and ecological exposure to materials at OU1 containing COC concentrations that exceed applicable risk-based cleanup criteria.
RAO 2	Mitigate the potential for COC-containing materials to migrate, by erosion or surface water runoff, into Portage Creek or onto adjacent properties.
RAO 3	Prevent contaminated waste material at the OU1 landfill from impacting groundwater and surface water.

In addition to the RAOs, the public has requested that the footprint of the landfills be reduced. The objective will be evaluated as part of the evaluation against USEPA's nine criteria.

2.3 Preliminary Remediation Goals

In general, PRGs provide remedial staff with criteria to use during analysis and selection of remedial alternatives. Chemical-specific PRGs are concentration goals for individual chemicals for specific medium and land use combination at CERCLA sites. Promulgated cleanup levels and risk-based concentrations are considered in developing PRGs.

2.3.1 PCBs

The PCB data representative of current conditions was compared with the PRGs to identify the media and volume within specific subareas of OU1 to be addressed by remediation. For the purpose of the FS, the lowest applicable criterion was applied to an area. For example, the criteria of 1.0 ~~2.5~~ mg/kg residential and 0.33 mg/kg surface sediment criteria protective of fish would both apply to surface sediments in a residential area. In this case, the lower criterion (0.33 mg/kg) was used to define the extent of remediation. In the instances where the detection limit is greater than the risk criterion, the detection limit is used.

Table 2-3 presents the OU1 PRGs for PCBs.

TABLE 2-3

Summary of Preliminary Remedial Goals Established by USEPA for PCBs

OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Medium	Pathway		PCB PRG	Basis
Soils	Human Health	Residential	1.0~~2.50~~ mg/kg	40 C.F.R. § 761.61(a)(4)
			2.5 mg/kg	
		Non-Residential	10~~16~~10 mg/kg	
			~~16 mg/kg~~	
	Ecological	Recreational	23 mg/kg	
		Aquatic	0.5–0.6 mg/kg	
		Terrestrial	6.5–8.1 mg/kg	
Subsurface Soils	Human Health	Residential	1.0 ~~2.5~~ mg/kg	
			2.5 mg/kg	
		Non-Residential	10 ~~16~~ mg/kg	
			16 mg/kg	
	Ecological	Recreational	23 mg/kg	
		Terrestrial	6.5–8.1 mg/kg	
Surface and Subsurface Sediments	Human Health	Fish Consumption	0.33 mg/kg	
	Ecological	Aquatic	0.5–0.6 mg/kg	
Groundwater (including seeps)	Human Health	Direct Contact	3.3 μg/L	MI Part 201 direct contact criteria
	Groundwater-Surface Water Interface (GSI)		0.2 μg/L	
Residuals	N/A		Qualitative: Where a removal is proposed, all visible residuals are to be removed unless analytical data are available to confirm PCBs (if present) are below applicable criteria.	

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TABLE 2-3
Summary of Preliminary Remedial Goals Established by USEPA for PCBs
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Medium	Pathway	PCB PRG	Basis

Notes:
[a]Based on high occupancy cleanup level (without conditions) set forth in 40 C.F.R. § 761.61(a)(4)
[b]Based on 40 C.F.R. 761.61(a)(4) with restrictive covenant prohibiting high occupancy use.
C ~~Recreational?~~Based on
[c]Default sediment criteria of 0.33 mg/kg will be applied to shallow soil in areas of periodic inundation due to the potential runoff of shallow soils into surface water. Evaluation of contaminated soil runoff to surface water required under R299.5728(f).
[de]Groundwater for use as drinking water is not considered a complete pathway so the Part 201 Drinking Water criteria of 0.5 microgram per liter (µg/L) was not used. The Part 201 direct contact criteria were used for protection of human health due to the presence of seeps.
[ef]The groundwater criteria protective of surface water is a PRG where the GSI is present (MCL 324.20120e and Part 31 .
mg/kg = milligrams per kilogram, µg/L = micrograms per liter, N/A = not applicable
Source: CH2M HILL 2009

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2.3.2 Contaminants of Concern

PCOCs are shown in Table 1-1. PCOCs were further evaluated against the PRG criteria and background concentrations to determine final COCs to be evaluated at OU1. The COCs retained for OU1, in addition to PCBs, are provided in Table 2-4. The highlighted values in Table 2-4 represent the lowest PRG criteria for each contaminant unless background is higher. If background is higher than the PRG criteria, the background value is used.

For this FS Report, OU1 subareas described in Section 1.2 were evaluated based on media (for example, soil or sediment) and, as appropriate, current land use and zoning (for example, residential, commercial, or manufacturing; a current land use and zoning map is included in Appendix C). Figure 2-1 depicts the subareas where PRGs are not currently being achieved and are classified according to PRGs and land use.

The volume of residuals, soils, or sediments that are present at OU1 with PCB concentrations above the relevant PRGs were estimated for each subarea. During the RI work, soil borings were sampled to characterize the vertical and horizontal extent of PCBs within OU1 and adjacent areas. Soil borings sampled during the RI work to determine the horizontal and vertical extent of PCB contamination in conjunction with field observations of extent and thickness of "gray clay" material and analytical data were used to estimate the volume of soils, residuals, and sediments in various areas of OU1 where PCBs exist at concentrations above the PRGs (Table 2-5). Note that the volumes in Table 2-5 are not targeted removal volumes. Removal volume estimates are developed for specific remedial alternatives presented in Section 4.

TABLE 2-4
Summary of Preliminary Remedial Goals for COCs
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

	Residential Soils/Sediments (µg/kg)				Groundwater (µg/L) and Seeps[a]	
Analyte	**Statewide Default Background Level**	**Residential Drinking Water Protection Criteria & RBSLs**	**Groundwater Surface Water Interface Protection Criteria and RBSLs**	**Direct Contact Criteria & RBSLs**	**Residential Drinking Water Criteria & RBSLs**	**Groundwater Surface Water Interface Criteria & RBSL**
SVOCs						
4-methylphenol	N/A	7,400	1,000	11,000,000	370	30
PCDD/PCDF[b]						
Total TCDD Equivalent[d]		NLL	NLL	0.09	N/A	
Inorganics						
Aluminum (B)	6,900,000	6,000,000	N/A	50,000,000	50	N/A
Antimony	N/A	4,300	94,000	180,000	6	130
Arsenic	5,800	4,600	4,600	7,600	10	10
Barium (B)	75,000 [c]	1,300,000	660,000 (G)	37,000,000	2,000	1,000 (G)
Cadmium (B)	1,200 [c]	6,000	3,000 (G)	550,000	5	2.5 (G)
Chromium	N/A	30,000	3,300	2,500,000	100	11
Cobalt	6,800	800	2,000	2,600,000	40	100
Copper	32,000 [c]	5,800,000	100,000 (G)	20,000,000	1,000	18 (G)
Cyanide	390	4,000	100	12,000	200	5.2
Iron (B)	12,000,000	6,000	N/A	160,000,000	300 (E)	N/A
Lead (B)	21,000 [c]	700,000	2,500,000 (G)	400,000	4	14 (G)
Magnesium (B)	N/A	8,000,000	N/A	1,000,000,000	400,000	N/A
Manganese (B)	440,000	1,000	26,000 (G)	25,000,000	50	1,300 (G)
Mercury	130	1,700	50	160,000	2	0.0013
Nickel	20,000 [c]	100,000	100,000 (G)	40,000,000	100	100 (G)

TABLE 2-4

Summary of Preliminary Remedial Goals for COCs

OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

	Residential Soils/Sediments (µg/kg)				Groundwater (µg/L) and Seeps[a]	
Analyte	**Statewide Default Background Level**	**Residential Drinking Water Protection Criteria & RBSLs**	**Groundwater Surface Water Interface Protection Criteria and RBSLs**	**Direct Contact Criteria & RBSLs**	**Residential Drinking Water Criteria & RBSLs**	**Groundwater Surface Water Interface Criteria & RBSL**
Selenium	410	4,000	400	2,600,000	50	5
Zinc	47,000[c]	2,400,000	230,000 (G)	170,000,000	2,400	235 (G)

[a]Only the data from the 2002–2003 groundwater and seep samples are summarized to reflect conditions after removal.

[b]Dioxin and furans were only sampled in 1998.

[c]Background value used in RI as screening criteria, lowest risk-based level highlighted used for COC comparison.

N/A = Not Applicable, NLL= Not likely to leach, RBSL = risk-based screening level, µg/kg = micrograms per kilogram

(B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion.

(E) Criterion is the aesthetic drinking water value, as required by Section 20120a(5) of the Natural Resources and Environmental Protection Act 1994 PA 451, as amended by the Natural Resources and Environmental Protection Act of 1994

(G) Calculated value dependent on ph, hardness

Highlighted cells = lowest applicable criteria

Source: Non-Residential Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 Risk-Based Screening Levels, document release date March 25, 2011.

TABLE 2-5

Media of Concern, Zoning Classification, and Estimated Volumes of PCB-containing Soils and Sediments Exceeding PRGs

OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Subarea	Media of Concern	Zoning Classification	Estimated Volume (yd^3)[a]	Estimated Area (acres)[a]
Former Operational Areas				
Monarch HRDL				
HRDL Disposal Area[b]	Soils, groundwater	Manufacturing	170,000	6.8
Former Raceway Channel	Sediments	Manufacturing	Less than 100	Less than 0.1
Former Type III Landfill[c]	Soils, groundwater	Manufacturing	405,000	13.6
Western Disposal Area				
Disposal Area[d]	Soils, groundwater	Manufacturing	270,000	13.2
Panelyte Property (southern end)	Soils	Manufacturing	4,000	1.4
Panelyte Marsh	Sediments	Manufacturing	300	0.9
Conrail Property	Soils	Manufacturing	Less than 100	0.1
Bryant HRDLs/FRDLs[e]	Soils, groundwater	Manufacturing	635,000	22.1
Residential and Commercial Properties[f]				
Residential Area				
Golden Age Retirement Community	Soils	Residential	1,100	Less than 0.1
Single-Family Residences	Soils	Residential	2,100	0.3
Lyondell Trust (formerly MHLLC)-owned property	Soils	Manufacturing	7,700	1.1
Commercial Properties				
Goodwill lawn	Soils	Manufacturing	28,500	1.7
Goodwill parking lots	Soils	Manufacturing	38,500	2.3
Goodwill beneath buildings	Soils	Manufacturing	8,500	0.5
Consumers Power	Soils	Manufacturing	1,100	Less than 0.1
Lyondell Trust (formerly MHLLC) Alcott Street Parking Lot	Soils	Manufacturing	12,000	0.7
Bryant Mill Property	Soils	Manufacturing	TBD[g]	TBD[g]

[a]All estimated volumes and areas are approximate. All areas and volumes are based on known or suspected presence of PCBs at any concentration.

[b]Monarch HRDL: The estimated area represents the total area of PCB-containing soils. Of the 6.8 acres, it is estimated that approximately 6 acres (135,000 yd^3) would be capped under a containment scenario, and that approximately 0.8 acre (35,000 yd^3) would comprise the remaining peripheral area.

[c]Former Type III Landfill: The estimated area represents the total area of PCB-containing soils. Of the 13.6 acres, it is estimated that approximately 10 acres (approximately 245,000 yd^3) would be capped under a containment scenario, and that approximately 3.6 acres (approximately 160,000 yd^3) would comprise the peripheral area.

[d]Western Disposal Area: The estimated area represents the total area of PCB-containing soils. Of the 13.2 acres, it is estimated that approximately 12 acres (245,000 yd^3) would be capped under a containment scenario, and that approximately 1.2 acres (25,000 yd^3) would comprise the peripheral area.

[e]Bryant HRDLs/FRDLs: The estimated volume associated with the Bryant HRDLs/FRDLs represents the volume of PCB-containing soil, not the total volume of soil. The total volume of soil associated with this area is approximately 725,000 yd^3, which includes approximately 90,000 yd^3 of clean soil cover.

[f]The volumes of PCB-containing soils within the Residential and Commercial Properties may be further refined based on additional delineation activities.

[g]TBD limited information is available on the Bryant Mill property, a predesign field investigation will be required to define the extent of contamination if present.

2.4 Redevelopment

OU1 lies within the Portage Creek Corridor. The City of Kalamazoo has developed plans for redevelopment of the land adjacent to Portage Creek. Goals of the plan include the following:

- Increasing the amount of land available for commercial and manufacturing use
- Creating a walking path parallel to Portage Creek
- Creating public open space

The remedial alternatives were developed to meet the RAOs, but may allow some or all of the redevelopment goals to be met. Discussion of remedial alternatives in Section 5 will include an evaluation of the redevelopment goals as presented in the plan.

2.5 General Response Actions

GRAs were identified after action-specific ARARs and remedial actions used, or considered for use, at similar sites were considered and reviewed. GRAs do not explicitly identify specific processes or materials to be used, but rather generic technology types that could be used individually or in combination.

The following GRAs can be applied to the RAOs for soils, sediment, and groundwater at OU1:

A. *No Action:* A baseline alternative was evaluated because it is required by CERCLA; however, the no-action alternative does not achieve the RAOs.

B. *Institutional Controls:* Implement administrative controls or legal requirements that help to minimize the potential for human or ecological exposure to contamination and protect the integrity of the remedy.

C. *Monitoring:* Monitor remedy performance through groundwater, landfill gas, and physical structures to identify areas of noncompliance.

D. *Monitored Natural Attenuation:* Reduce the bioavailability of PCBs over time through natural processes, and monitor the performance of those processes as compared with expected results.

E. *In Situ Containment:* Consolidate onsite soils and sediments in an engineered disposal area at OU1, apply a fully encapsulated landfill containment, implement erosion controls, and implement hydraulic modifications.

F. *In Situ Treatment:* Treat in-place soil and sediment to reduce mobility, toxicity, or volume.

G. *Removal:* Excavate soil and sediment, and collect and treat groundwater.

H. *Ex Situ Treatment:*

   - Employ water treatment technologies (for example, activated carbon) to reduce the volume, mobility, and concentrations of PCBs in water prior to discharge to the Portage Creek.

   - Treat soil and/or sediment at an offsite permitted treatment facility to reduce PCB volume, mobility, and concentrations.

I. *Transportation and Disposal:*

   - Transport offsite soil and sediment to a permitted landfill facility for disposal. (The type of facility would be selected based on the PCB concentrations in the materials to be disposed. Materials with PCB concentrations equal to or above 50 mg/kg are required to be disposed in a TSCA-regulated landfill, while materials with PCB concentrations below 50 mg/kg are disposed of in solid waste landfills.)

   - Consolidate materials excavated into onsite locations designated as a landfill.

SECTION 3

33 Identification and Evaluation of Technologies

A range of potentially applicable remedial technologies and process options were identified and evaluated against the RAOs for OU1. In accordance with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988), the identified technologies were evaluated in two steps. First, an array of possible remedial technologies was evaluated based on the potential for technical implementability at OU1. The evaluation was based on the PCB data gathered during the RI, the media of concern, and the specific characteristics of OU1. Technologies that cannot be feasibly implemented were eliminated. Next, the remaining technologies were further evaluated based on overall effectiveness, implementability, and relative cost. Representative technologies retained following this screening step were then assembled into a range of potential remedial alternatives. The process is described in more detail in the following subsections.

3.1 Identification and Screening of Remedial Technologies and Process Options

A variety of potential technologies and process options associated with each GRA were compiled based on OU1-specific GRAs defined in Section 2.5. Remedial technologies are considered as general categories of technologies, while process options refer to specific processes within each technology type (USEPA 1988). For example, erosion control is a specific remedial technology in the more general in situ containment GRA, and sheet pile wall installation is a process option under erosion control.

Remedial technologies and process options were first evaluated based on their technical implementability at OU1. The general evaluation of the technical implementability considered three factors: (1) whether the remedial technology or process option is applicable with respect to specific OU1 conditions, (2) whether implementation is feasible, and (3) whether the technology has been fully developed for use. The analysis is based on prior knowledge of the conditions at OU1 and the Site, information from other similar sites, and scientific literature. The initial screening step was conducted to reduce the number of potential remedial technologies that were to be evaluated more rigorously. Only process options and entire technology types that could be effectively implemented at OU1 were carried forward to the next step.

Table 3-1 identifies GRAs and screens potential remedial technologies and process options that could reasonably be applied to soils, sediments, and groundwater at OU1. The table also identifies the media to which the option might apply and a preliminary assessment of technical implementability. Process options that did not meet the technical implementability criteria as described above were eliminated from further evaluation.

In some cases, only one representative process option was carried forward for further evaluation (Table 3-1). Selecting specific representative process options is intended to streamline the development of potential remedial alternatives. An eliminated process option could still be considered during remedial design if its technology type was part of the selected remedial alternative.

The approach is in accordance with USEPA guidance (1988), which states the following:

> *One representative process is selected, if possible, for each technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase.*

For example, in the transportation remedial technology, while both rail and truck transport are feasible approaches, only truck transport was retained as the representative process option and carried through for further analysis. If offsite disposal is selected as the remedial alternative, then rail transport might be further considered.

3.2 Evaluation of Process Options

The next step of the remedial technologies screening process is to further evaluate the remedial process options retained at the end of the first step (Table 3-1). Within each remaining GRA, remedial technologies were identified and screened based on effectiveness, implementability, and relative cost. The criteria are defined as follows:

- **Effectiveness** is the ability of the technology or process option to perform adequately to achieve the remedial objectives alone or as part of an overall system. It may be considered as a function of long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, or short-term effectiveness.
- **Implementability** refers to degree of difficulty expected in putting into place a particular measure under practical technical, regulatory, and schedule constraints.
- **Relative cost** is comparative only and is judged similar to the effectiveness criterion. It is used to preclude further evaluation of process options that are very costly where there are other choices that perform similar functions with comparable effectiveness. It includes construction and long-term operation and maintenance (O&M) costs.

Table 3-2 presents the results of the second screening phase in terms of effectiveness, implementability, and cost. Representative process options for each technology type were retained for incorporation into the range of potential remedial alternatives based on the two-step evaluation and technology screening process. Consistent with state and federal guidance, the No Further Action GRA was retained as a baseline against which other remedial alternatives will be evaluated.

Process options were eliminated during this second screening step if the option met any of the following criteria:

1. It did not effectively meet the RAOs established in Section 2.2.
2. It was not applicable to PCBs, conditions at OU1, or the media of concern.
3. It was not sufficiently demonstrated at pilot scale or full scale.
4. It was similar to other retained options but had a much higher relative implementation cost.

Each eliminated process option is shaded in Table 3-2, and the following briefly describes the elimination rationale:

- **Ex Situ Treatment—Basic Extractive Sludge Treatment:** This option was not retained based on the following:
  - Reduction of toxicity, mobility or volume through treatment—This approach has not been shown to effectively treat PCBs in paper-making residuals to meet goals.
  - Implementability—Limitations based on scale of OU1 and quantity of PCB-containing materials subject to treatment.
- **In Situ Treatment—Solidification:** This option was eliminated based on the following:
  - Reduction of toxicity, mobility, or volume through treatment—Little or no gain achieved in immobilization over current conditions due to PCBs affinity for residual materials.
  - Reduction of toxicity, mobility, or volume through treatment—No reduction in hydraulic conductivity of waste material. Waste has hydraulic conductivity of 1×10^{-7} cm/s, lower than what is sometimes achieved by solidification).
  - Reduction of toxicity, mobility, or volume through treatment—Significant increases in the volume of waste occur due to the addition of the solidifying agent. Increases can be in the range of 15 percent or more.
  - Does not eliminate the need for a cover to protect against direct contact of waste material.

3.3 Assembly of Alternatives

A summary of response actions by subarea can be found in Table 3-3.

The alternatives assembled from the retained process options are listed below. Section 4 describes each alternative in detail, and Sections 5 and 6 evaluate them with respect to the relevant CERCLA criteria.

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- Alternative 1—No Further Action
- Alternative 2—Consolidation and Capping

a) Consolidate Outlying Areas on the Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal areas with the following steps:

  - Excavate Outlying Areas
  - Excavate and pull back perimeter around Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal areas
  - Pull back Monarch HRDL
  - Install cap on Bryant HRDL/FRDL, Former Type III Landfill, Western disposal areas, and Monarch HRDL
  - Implement restrictive covenant to limit use in commercial areas)
  - Implement restrictive covenant to prohibit interference with the paved areas, caps and fences
  - Implement restrictive covenant to prohibit groundwater use
  - Restore wetlands ~~and~~ ~~Implement~~ implement restrictive covenant to maintain wetland areas.
  - Monitor groundwater to verify effectiveness

b) Consolidate Outlying Areas and Monarch HRDL on Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal areas with the following steps:

  - Excavate Outlying Areas
  - Excavate Monarch HRDL
  - Excavate and pull back perimeter around Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal area
  - Install cap on Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal area
  - Implement restrictive covenant to limit use in commercial areas
  - Implement restrictive covenant in capped areas to prohibit interference with the cap~~, to prohibit interference with~~and fences and to prohibit groundwater use
  - Restore wetlands and ~~Implement~~ implement restrictive covenant to maintain wetland areas.
  - Monitor groundwater to verify effectiveness

c) Consolidate materials from Outlying Areas and Monarch HRDL with a PCB concentration of 500 mg/kg or less on Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal areas and offsite incineration of soils/sediment with PCB concentrations above 500 mg/kg with the following steps:

  - Excavate Outlying Areas
  - Excavate Monarch HRDL
  - Excavate and pull back perimeter around Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal area
  - Restore wetlands and ~~Implement~~ implement restrictive covenant to maintain wetland areas
  - Offsite incineration of material with PCB concentration s above 500 mg/kg
  - Consolidate materials with PCB concentrations of 500 mg/kg or less on Bryant HRDL/FRDL, Former Type III Landfill and Western disposal area
  - Install cap on Bryant HRDL/FRDL, Former Type III Landfill, and Western disposal area

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- Implement institutional controls, where necessary
- Monitor groundwater to verify effectiveness

d) Employ groundwater options

- Optional—groundwater hydraulic control and treatment
- Optional—slurry cut-off wall with hydraulic control and treatment

- Alternative 3—Total Removal and Offsite Disposal
  - Implement restrictive covenant to limit use in commercial areas
- Alternative 4—Encapsulation Containment System
  - ~~a)~~ Excavate Outlying Areas , Bryant HRDL/FRDL, Former Type III Landfill, Western disposal areas, and Monarch HRDL and stockpile
  - ~~b)~~ Line bottom of OU1
  - ~~c)~~ Place consolidated material within the lined OU1 area
  - ~~d)~~ Install cap
  - Implement restrictive covenant to limit use in commercial areas
  - -Implement restrictive covenant in capped areas to prohibit interference with the cap~~, to prohibit interference with~~and fences and to prohibit groundwater use
  - Restore wetlands and ~~I~~implement restrictive covenant to maintain wetland areas.
  - Monitor groundwater to verify effectiveness

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Groundwater monitoring is included in all of the alternatives that leave waste in place or consolidated onsite. Monitoring will include up- and downgradient wells to determine if COCs are migrating offsite. For Alternative 2 options, the following two subalternatives will be considered:

- Subalternative (i)—Groundwater collection and treatment, which includes a system of extraction wells or trenches installed downgradient to capture groundwater before discharge to Portage Creek.
- Subalternative (ii)—Slurry wall installed downgradient of groundwater flow along with extraction wells or trenches to prevent groundwater mounding behind the slurry wall.

The City of Kalamazoo requested that USEPA consider a slurry wall that fully encompasses the landfills. The evaluation of a slurry wall has been included; however, under subalternative ~~alternativealternativesubalternative~~ (ii) the wall would be constructed only downgradient of the landfill, which provides a similar level of protection for Portage Creek, mitigates the potential for affecting adjacent property owners upgradient of the wall, and reduces the cost of the wall by half.

The existing sheet pile wall will be evaluated during design to determine if it can be removed completely or is required to stabilize the base of the landfill along Portage Creek for onsite alternatives. If the wall is required for stabilization, the wall will be cut off at ground surface and individual panels may be removed to allow groundwater flow to the creek, eliminating the need for the existing collection system.

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SECTION 4

~~4~~4 Potential Remedial Alternatives

Based on the results of the screening steps described in Section 3, the specific technologies and process options retained were assembled into a series of potential remedial alternatives that could be implemented to achieve the RAOs established for OU1. The remedial alternatives, with the exception of Alternative 1 (No Further Action), are developed to prevent erosion, direct contact, and groundwater impacts. The range of alternatives presented were developed consistent with USEPA guidance (1988), which states that alternatives with the "most favorable composite evaluation of all factors [that is, effectiveness, implementability, and cost] should be retained for further consideration during the detailed analysis." The USEPA guidance also states that the alternatives developed should "provide decision makers with an appropriate range of options" and "form alternatives for the Site as a whole." To the extent possible, the alternatives should represent "distinct viable options."

Section 4 details the potential remedial alternatives for OU1—ranging from no further action to consolidation of containments onsite to the complete removal and offsite disposal of all COC-containing materials.

4.1 Common Elements of Alternatives

For all alternatives except Alternative 1 (No Further Action), predesign investigations are required to further delineate the nature and extent of concentrations of COCs exceeding the relevant PRGs in certain subareas of the Site as discussed below. ~~-~~Based on the RI, it is assumed that by addressing PCBs, other COCs will be addressed. Confirmation sampling will be performed during the implementation of the remedial action to verify the assumption. ~~Additional surface and subsurface sampling will likely be necessary as part of a predesign investigation at the Alcott Street parking lot, Panelyte Marsh, and Panelyte Property~~

•Residential Subarea (Outlying): During predesign, the subarea identified as "Residential Properties" in Figures 4-2A, 4-2B, 4-3 and 4-4 will be sampled for PCBs. If soil levels exceed the clean up level of 1 ppm PCBs then the soils will be excavated and backfilled with clean material to achieve a cleanup level of less than 1 ppm PCBs. ~~as well as in the outlying areas including the lawn area on the Goodwill property, beneath the parking lots on the Goodwill property, the Consumers Power property, the Golden Age Retirement Community property, several single-family residential properties, and the adjacent Lyondell Trust (formerly MHLLC) property. The results of the predesign work would be used to define the remedial response for the areas. Details of the predesign work would be developed once a final remedy is selected.~~

•Commercial Properties (Outlying): During predesign, the exposed soils of the area identified as Commercial Properties in Figures 4-2A, 4-2B, 4-3 and 4-4 will be sampled and if exposed soil exceeds the cleanup level of 1 ppm PCBs, then the soils will be excavated and backfilled with clean material to achieve a cleanup level of less than 1 ppm PCBs. Subsoils beneath the Alcott Street parking lot, the paved areas on the Goodwill property and the Consumers Power property will be sampled as well. Subsoils beneath a paved surface will likely remain in place and a restrictive covenant prohibiting interference with the paved surfaces will be required if PCBs are present that exceed 1 ppm PCBs. Where there are structures that serve to mitigate direct contact and hinder the ability to remove impacted materials, restrictive covenants will be employed that requiring sampling and removal when existing structures are compromised.

•Property Owned by Lyondell Trust (former Bryant Mill property outh of Alcott Street): This area will be sampled during predesign and soils will be excavated to achieve a cleanup level of less than 10 ppm PCBs. A restrictive covenant will be required to prohibit high occupancy use on this area.

•Former Filter Plant

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Commented [JC24]: Are we sampling underneath homes?

Commented [GU25]: no

Commented [JC26]: Is the soil exposed at the "Commercial Properties? I would like to go with 1 ppm here….I don't want a covenant for exposed soils at an existing commercial establishment

Commented [JC27]: Are there any exposed soils or are all soils underneath pavement? I am ok with covenant prohibiting interference with cover.

Commented [JC28]: The Trust will implement a restrictive covenant --- and so no problem with covenant here prohibiting high occupancy use.

Commented [JC29]: Need discussion here..predesign sampling – PRG for excavation? Restrictive covenant?

•Former Bryant Mill Pond Area: During predesign the Former Bryant Mill Pond will be sampled for .....; An environmental covenant will be implemented to maintain wetland area in the Former Bryant Pond Area.

•Panelyte Marsh – During predesign this area will be sampled. ..... identify PRG – restrictive covenant maintaining wetlands.

•Panelyte Property During predesign this area will be sampled. ..... identify PRG – restrictive covenant maintaining wetlands.

•Portage Creek Floodplain: Wetlands will be restored in this area and ~~and~~ an environmental covenant will be implemented to maintain the wetland area.

•Former Raceway Channel: During predesign.....Excavation will be conducted to a the PRG of Wetlands will be restored in this area and an environmental covenant will be implemented to maintain the wetland area.

•Clay Seam and East Bank Area: Sampling of these areas have demonstrated that they meet a cleanup level below 1 ppm PCBS and thus no further action is anticipated in these areas.

~~Similarly, all alternatives other than Alternative 1 include some form of institutional controls (for example, deed restrictions and access restrictions). Predesign investigation may be required in the Former Bryant Mill Pond Area to confirm current conditions with potential institutional controls contingent on the results~~.

All alternatives also incorporate a groundwater monitoring program that would include installation and periodic sampling of sentinel wells according to a plan developed by USEPA. According to RAO 3, the purpose of the program is to monitor the performance of the remedy. The groundwater monitoring plan would also evaluate upgradient groundwater concentrations for determination of local background conditions. The groundwater monitoring plan will also be developed to demonstrate compliance with GSI criteria at Portage Creek under MCl 324.20120e for containment alternatives. Potential components of a groundwater remedy are described in Section 4.3 as subcomponents of Alternative 2 options.

The 2,600 linear feet of sealed-joint sheet pile installed in 2001 along the western bank of Portage Creek was installed to stabilize the perimeter berms of the Bryant HRDLs and FRDLs. ~~It is expected to be maintained under Alternative 1 (No Further Action).~~ Except for Alternative 1, p~~P~~artial or complete removal of the existing sheet pile wall has been evaluated as a component of the other alternatives.

~~As described in detail in Section 1.3, no additional remedial activities are proposed for the Former Bryant Mill Pond Area, the East Bank, and the Clay Seam Area as part of this FS.~~

Commented [JC30]: Please identify type of sampling that will be done here and type of restrictive covenant needed?

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Commented [JC33]: Each of these areas needs to be discussed above – ROD will need to make a finding.

4.2 Alternative 1—No Further Action

The No Further Action alternative is required in the FS under the National Oil and Hazardous Substances Pollution Contingency Plan and serves as a baseline against which the other potential remedial alternatives can be compared.

No further active remediation would be performed in any portion of OU1 under this alternative. Natural attenuation processes would continue, but would not be monitored to gauge progress toward the RAOs. The potential for human and ecological receptors to be exposed to COCs would not be addressed, and there would remain a potential for COCs to erode into Portage Creek over time since there would be no maintenance of the existing fence, cap, soil cover, or the other engineered control systems. Operation of the groundwater collection/treatment system would be discontinued. Alternative 1 is depicted in Figure 4-1.

4.3 Alternative 2—Consolidation and Capping

The primary element of Alternative 2 is in-place containment with erosion control measures including consolidation of the Outlying Areas into the Bryant HRDLs/FRDLs and Monarch HRDL. The Bryant HRDLs/FRDLs

Area will include the adjacent Former Type III Landfill and Western Disposal Areas. Alternative 2, described in the following section, was developed to present options for addressing the Outlying Areas within OU1. Three variations of Alternative 2 were developed, Alternatives 2A, 2B, and 2C, to allow for variations in the consolidation of the excavated materials. Alternative 2 is depicted in Figures 4-2a, and 4-2b.

Alternative 2 includes covering the landfills after consolidation with an engineered composite landfill cap. A clean set back will be left between the landfill and Portage Creek to allow room for monitoring wells and an optional groundwater collection treatment system. For the purpose of FS cost estimating, it is assumed the cap will consists of six layers. The layers are (from bottom to top): a non-woven geotextile, a 12-inch-thick (minimum) sand gas venting layer, a 30-millimeter polyvinyl chloride FML or equivalent (permeability less than 10^{-10} cm/sec), a geosynthetic drainage composite layer, a 24-inch-thick (minimum) drainage and soil protection layer, and a 6-inch-thick (minimum) vegetated, topsoil layer. The proposed cap design achieves the landfill cap ~~has the same~~ components ~~as~~ under the Natural Resources and Environmental Protection Act of 1994 (NREPA), as amended, Part 115.

~~In the Outlying Areas where there are structures that serve to mitigate direct contact and hinder the ability to remove impacted materials, institutional controls will be employed that will be protective at the time contaminated material is exposed if concentrations of COCs are present above PRGs or when existing structures are compromised in a manner that allows for cleanup of contaminated material.~~

Once excavation is complete, post-excavation confirmatory sampling and analysis would be performed to document that the cleanup goals have been reached. The excavated areas would then be backfilled with clean material, graded to mitigate ponding, and revegetated. ~~T~~.

During predesign, The shaded area of the Panelyte Property identified in Figures 4-2A, 4-2B will be sampled and... During predesign, the shaded area of the Panelyte Marsh identified in Figures 4-2A, 4-2B will be sampled material will be excavated in these areas to achieve a PRG he Panelyte Marsh, Former Monarch Raceway Channel and other wetlands would be backfilled to existing grades and wetlands will be restored via ~~to promote the~~ re-establishment of native vegetation. Restrictive covenants are required to maintain the wetlands area.

Alternative2 options include long-term inspections and maintenance of the existing and newly installed engineered landfill caps, and the remaining sheet pile. A long-term monitoring program will be implemented to verify that groundwater quality conforms to applicable risk-based standards and GSI criteria and to provide for the appropriate management of landfill gas.

A groundwater monitoring network consisting of existing and new monitoring wells (as needed) will be located outside areas where waste remains in place (Bryant HRDLs/FRDLs and or/Monarch HRDL Areas). For the purposes of the FS, it was assumed that 24 monitoring wells would be installed for monitoring in Alternative 2A, and 20 monitoring wells will be installed as part of Alternatives 2B and 2C. The monitoring wells will be sampled in accordance with NREPA Part 201 and (40 CFR § Section 761.75(b) (6). Following each sampling event, the analytical results will undergo data validation, and the validated analytical results will be compared to Michigan Act 451 Part 201 Generic Screening Criteria. Analytical results from groundwater samples collected from monitoring wells adjacent to Portage Creek will be compared to the GSI criterion. Analytical results for samples taken in non-GSI areas will be compared to other appropriate criteria (for example, Groundwater Protection Screening Criteria).

Alternative 2 options include subalternatives for hydraulic control of groundwater. For subalternative (i) USEPA would install a groundwater collection and treatment system. The groundwater collection and treatment system would be built and placed in operation at OU1. The groundwater collection and treatment system would consist of groundwater extraction wells and a series of sumps and lateral drain lines. For subalternative (ii), a grout slurry wall would be installed downgradient of the Bryant HRDLs/FRDLs and Monarch HRDL (if left in place) to contain impacted groundwater located within OU1 as subalternative (ii). The slurry wall would extend approximately 40 feet below ground surface based on current sheet pile wall design. It is assumed that the slurry wall will not necessarily key into clay or bedrock—portions of the slurry wall at this depth would still terminate in the upper sand zones. Subalternative (ii) includes the same groundwater collection and treatment system as Subalternative (i).

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Commented [JC36]: Panelyte Marsh seems to be common elements area? I think this discussion can go in the common elements section. Please identify sampling and PRG for Panelyte area – restrictions?

Commented [JC37]: Panelyte Marsh seems to be common elements area? I think this discussion can go in the common elements section. Please identify sampling and PRG for Panelyte area – restrictions?

Alternative 2 includes ~~institutional controls (for example, deed restrictions~~restrictive~~restrictions~~restrictiverestrictive covenants to prevent exposure of PCBs at depth, prohibit interference with the cap and informational devices) and access restrictions (perimeter fence with posted warning signs). ~~The institutional controls would be implemented at Outlying Areas and the onsite disposal areas to prevent actions that might result in direct contact with COC-containing materials that remain.~~

Commented [JC38]: I moved to common elements section

~~4.3.1~~Alternative 2A—Consolidation of Outlying Areas on HRDL/FRDL and Monarch HRDLs

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Under Alternative 2A, the "Common Element" ~~Outlying~~ Areas and certain areas located within the operational unit and perimeter areas around the landfills would be excavated and consolidated on the Bryant HRDLs/FRDLs and Monarch HRDL. The offsite and perimeter areas targeted for consolidation are shown in Figure 4-2a. After consolidation, each landfill would be covered with an engineered cap as described in Section 4.3.

Portions of the Bryant HRDLs/FRDLs, Monarch HRDL, Former Type III Landfill, and Western Disposal Area perimeter will be excavated/pulled back and consolidated within the onsite disposal areas to create a setback that will act as a protective buffer along the creek and to enhance long-term slope stability. This alternative includes the pull-back of waste from the creek and removal of the sheet pile wall. The need to leave portions of the sheet pile wall in place for landfill slope and bank stability will be further evaluated in the design should the alternative be selected.

~~4.3.2~~4.3.1 Alternative 2B—Consolidation of Outlying Areas and the Monarch HRDL on HRDL/FRDL

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Under Alternative 2B, the material from the "Common Element ~~Outlying~~ Areas, certain areas located within the operational unit and perimeter areas around the landfills ~~and~~ the Monarch HRDL would be consolidated on the Bryant HRDLs/FRDLs Landfill. The perimeter area excavation and subsequent capping of the entire Bryant HRDLs/FRDLs would be conducted as described in Alternative 2A.

Portions of the perimeter around the Former Type III Landfill and Western Disposal Area would be pulled back and consolidated on the Bryant HRDLs/FRDLs Landfill and capped as described in Section 4.3.

~~4.3.3~~4.3.2 Alternative 2C—Consolidation of Outlying Areas and the Monarch HRDL on HRDL/FRDL with Offsite Incineration of Excavated Materials with PCBs Greater than 500 mg/kg

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Under Alternative 2C, the Common Elements ~~Outlying~~ Areas and the Monarch HRDL would be consolidated on the Bryant HRDLs/FRDLs Landfill. The perimeter area excavation would be conducted as described in Alternative 2A. Portions of the perimeter around the Former Type III Landfill and Western Disposal Area would be pulled back and consolidated on the Bryant HRDLs/FRDLs Landfill. Excavated materials with PCB concentrations above 500 mg/kg would be transported for offsite incineration. Remaining materials with PCB concentrations of 500 mg/kg or less would be consolidated on the Bryant HRDLs/FRDLs and subsequently capped.

The design investigation will be used to identify hot spots within the area to be consolidated with PCB concentrations greater than 500 mg/kg. For the purpose of the feasibility study, it is assumed that approximately 5 percent of the soils excavated from the pullback near the Western Disposal Area and Former Type III Landfill would require offsite incineration. Approximately 2 percent of soils excavated from Outlying Areas, Monarch HRDL, and the setback between Portage Creek and Bryant HRDLS/FRDLs would require offsite incineration. These assumptions are based on the cumulative distribution functions performed in a statistical evaluation by the USEPA FIeld EnvironmentaL Decision Support (FIELDS) Team using the existing data sets (Appendix E).

4.4 Alternative 3—Total Removal and Offsite Disposal

The primary element of Alternative 3 is the excavation and offsite disposal of all areas. The excavation areas are shown on Figure 4-3 and include the following:

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- ~~The Common Elements areas All offsite outlying areas other than the portion of the Goodwill property that may be covered by buildings~~
- Former Operational Areas—The Monarch HRDL, the Former Type III Landfill, the Western Disposal Area and the Bryant HRDLs/FRDLs
- Other ~~onsite~~ areas with PCB-containing materials that lie close to Portage Creek, including the Panelyte Marsh, the Panelyte Property, and the Conrail Property

Commented [JC39]: This is not shown on the map?

Materials will be excavated and transported directly to offsite commercial landfills. Materials with PCB concentrations of 50 mg/kg or greater would be transported to and disposed of in approved offsite landfills permitted to receive TSCA-regulated wastes. Materials with PCB concentrations less than 50 mg/kg would be transported to and disposed of at other permitted and approved landfills as appropriate. Excluded from removal are the PCB-containing materials that may be located under existing buildings on the Goodwill property.

Post-removal confirmatory sampling and analysis would be performed at the excavation areas. Once cleanup goals have been achieved, the excavated areas would be backfilled with clean material, graded to mitigate ponding, and revegetated or otherwise restored to match the surrounding areas. The Panelyte Marsh, the Former Monarch Raceway Channel, and other wetland areas would be backfilled to existing grades and restored to promote the re-establishment of native vegetation. The excavated and backfilled area would extend across approximately 65 acres. Restrictive covenants to maintain wetlands areas will be required.

In addition, part of this alternative would include the removal of 2,600 linear feet of sealed-joint sheet pile along the western bank of Portage Creek to the extent feasible. The groundwater treatment system would be decommissioned and removed, and the network of groundwater extraction trenches, sumps, and wells currently in place behind the sheet pile wall would be removed and disposed.

This alternative is developed with the intent of removal of all material containing COCs above OU1 PRGs. However, if it is not feasible to remove some of the material, groundwater monitoring would be performed in areas where exceedances remain. Monitoring would be performed as described in Section 4.3. Institutional controls (for example, ~~deed restrictions~~restrictive~~restrictions~~restrictiverestrictive covenants and enforcement tools) would be implemented for the areas where COCs may be left in place ~~(for example, beneath the existing buildings on the Goodwill property), to prevent actions that might result in direct contact with these materials.~~

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~~4.5~~Alternative 4—Encapsulation Containment System

The primary element of Alternative 4 is the full encapsulation of impacted materials onsite as shown in Figure 4-4, including the following:

- Excavate approximately 1,600,000 yd^3 of soil and/or sediment containing PCBs above the relevant PRGs and then place them in a series of full-encapsulating cells
- Construct a landfill bottom liner in previously excavated former landfill areas
- Place excavated materials on the newly constructed landfill liner
- Excavate and consolidate other onsite areas with PCB-containing materials in the new landfill areas
- Construct a landfill cap over the new landfill areas (same construction as Alternative 2 in Section 4.3)
- Some materials could be volumetrically displaced and would be disposed of in offsite commercial landfills

~~4.5.1~~4.4.1 Description of Alternative

The same areas identified in Alternative 2 are targeted for excavation in Alternative 4 (Figure 4-4). ~~Excluded from removal are the PCB-containing materials that may be located under existing buildings on the Goodwill property.~~

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In the outlying areas, once cleanup goals have been achieved, the excavated areas would be backfilled with clean material, graded to mitigate ponding, and revegetated or otherwise restored to match the surrounding area. The Panelyte Marsh and Former Monarch Raceway Channel would be backfilled to existing grades and restored to promote the re-establishment of native vegetation. All excavated materials would be sequentially stockpiled onsite during construction of a series of landfill containment cells, constructed onsite in the locations of the current Former Operational Areas. Post-removal confirmatory sampling and analysis would be performed at the excavation areas. The Panelyte Marsh, the Former Monarch Raceway Channel, and other wetland areas would be backfilled to existing grades and restored to promote the re-establishment of native vegetation.

Work in the Former Operational Areas could be carried out in the following manner:

- Excavate soils from the Monarch HRDL and temporarily stage the soils in the Western Disposal Area. Backfill the Monarch HRDL with approximately 10 feet of imported clean fill to establish the base liner 4 feet above the water table for the disposal cell. Construct the base liner, transport approximately 75 percent of the excavated Monarch HRDL soils back to the Monarch cell, place/grade/compact the soils, and construct the final cap. The remaining 25 percent of soils volumetrically displaced would be transported offsite for disposal.
- Repeat the above process for the Bryant HRDLs/FRDLs, then the Former Type III Landfill.
- Repeat the above process for the western half of the Western Disposal Area, but do not construct the final cap.
- Complete the process for the eastern half of the Western Disposal Area, and then construct the final cap over the entire Western Disposal Area.

The containment system disposal cells would be designed and built to include a double composite base liner system constructed a minimum distance of 10 feet above the groundwater table and graded to a minimum slope of 2 percent to promote drainage. For the purposes of FS cost estimating, it is assumed the base liner system would consist of the following components, from top down: a 40-mil primary FML, underlain by a geosynthetic clay liner (GCL), a leachate collection system consisting of a geosynthetic drainage composite (GDC) layer (consisting of a geonet that is heat-bonded on each side to a non-woven needle-punched geotextile) draining to a pumpable sump system, a leak detection system, a secondary 40-mil FML, and a secondary 3-foot compacted clay liner (or geosynthetic equivalent). The GCL would have a maximum hydraulic conductivity of 10^{-7} centimeters per second, and the GDC would have a minimum transmissivity of 3×10^{-4} square meters per second.

The removed materials would be placed within the disposal cells with a cover liner system sloped to grades of no less than 4 percent and consisting of the following components, from top down: a 6-inch vegetative soil layer, a 24-inch protective soil layer, a GDC (as described above), a 40-mil FML, a GCL, a non-woven needle-punched geotextile, a minimum 12-inch gas-venting layer with gas vents at appropriately spaced intervals, a basal non-woven needle-punched geotextile, and a soil grading layer. The cap would be constructed with appropriate erosion controls and other measures to protect against flood events and other natural or human-induced incidents that might otherwise threaten the integrity of the disposal areas. The final cap would cover approximately 50 acres.

Excess excavated materials that do not fit in the landfill containment cells (height of the cells is limited due to the need to attain the desired side slope grade) would be transported to and disposed of in appropriately permitted offsite landfills. Approximately 25 percent of the soils targeted for excavation and re-emplacement in the Former Operational Areas and all of the soils excavated from the offsite outlying areas would be volumetrically displaced, which means that more than 460,000 yd^3 of materials would have to be transported offsite for disposal.

The materials would be transported to and disposed of in offsite landfills. Materials with PCB concentrations of 50 mg/kg or greater would be transported to and disposed of in approved offsite landfills permitted to receive TSCA-regulated wastes. Materials with PCB concentrations less than 50 mg/kg would be transported to and disposed of at other permitted and approved landfills as appropriate. Excluded from removal are the PCB-containing materials that may be located under existing buildings on the Goodwill property. Excavated areas will be backfilled with clean material, graded, and revegetated or otherwise restored to match the surrounding areas. The excavated and backfilled area would extend across approximately 65 acres.

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In addition, part of this alternative would include removal of 2,600 linear feet of sealed-joint sheet pile along the western bank of Portage Creek. The need to leave portions of the sheet pile wall in place for landfill slope and bank stability will be further evaluated in the design should this alternative be selected. The potential for groundwater mounding behind the wall will be included as part of the evaluation. The groundwater treatment system would be decommissioned and removed, and the network of groundwater extraction trenches, sumps, and wells currently in place behind the sheet pile wall would be removed and disposed.

~~4.5.1.1~~4.4.1.1 Groundwater Monitoring

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Under Alternative 4, USEPA would establish the groundwater monitoring system as described in Section 4.3 for Alternative 2 options.

SECTION 5

5 Detailed Evaluation of Remedial Alternatives

Each potential remedial alternative identified in Section 4 was assessed in accordance with guidelines set forth in CERCLA. Key elements considered in the evaluation of each alternative included the following:

- **Overall Protection of Human Health and the Environment**—This element assesses the overall effectiveness of an alternative in protecting human health and the environment by reducing potential exposures and achieving the identified RAOs. This element considers whether the alternative reduces risks and maintains protectiveness over time and whether the alternative meets RAOs.
- **Compliance with Applicable or Relevant and Appropriate Requirements**—This element assesses whether an alternative complies with identified ARARs or whether waivers are necessary.
- **Long-term Effectiveness and Permanence**—This element assesses the effectiveness of an alternative with respect to reducing exposure and potential risk and the ability to maintain protectiveness over time. This element considers whether the alternative maintains protection of human health and the environment after RAOs have been met.
- **Reduction of Toxicity, Mobility, or Volume through Treatment**—This element assesses expected reductions in toxicity, mobility, or volume of impacted media.
- **Short-term Effectiveness**—This element assesses short-term impacts to human health and the environment related to construction and implementation of an alternative. This element considers the short-term environmental impacts of construction, the protection of onsite workers and the neighboring community, and the duration until the RAOs are achieved.
- **Implementability**—This element assesses the implementability of an alternative with respect to both technical and administrative feasibility, including the availability of appropriate services and materials. Technical implementability includes the ability to construct and operate the technology, the reliability of the technology, and the ability to effectively monitor the technology. Administrative feasibility includes the degree to which any coordination with other government agencies (including local governments) can be achieved. This element considers whether implementing an alternative is technically and administratively feasible, whether trained workers, equipment, and materials are readily available, and how long it will take to implement an alternative.
- **Cost**—This element assesses capital, O&M, and the present worth of implementing an alternative. Present-worth costs, where appropriate, are developed using a discount rate of 7 percent based on Office of Solid Waste and Emergency Response Directive No. 9355.3-20 (USEPA 1993). In consideration of engineering and construction contingencies, the feasibility-level costs are typically estimated with an accuracy in the range of +50 percent to −30 percent. This element considers the cost to implement and maintain an alternative and monitor its effectiveness.

Each alternative is evaluated individually based on the seven elements presented above followed by a comparative assessment in Section 6. The results of the evaluations will be used by USEPA in the identification of a recommended alternative for OU1.

USEPA addresses the CERCLA criteria of State Acceptance and Community Acceptance in the development of the Record of Decision (ROD). The ROD will establish the cleanup standards for OU1. The cleanup standards may be PRGs presented in Section 2.3 or modified as deemed appropriate. PRGs are used in this section for the evaluation of the remedial alternatives prior to the establishment of the cleanup standards. The cleanup criteria will be carried forward into the remedial design.

5.1 Alternative 1—No Further Action

Development of a no further action alternative is required under the National Oil and Hazardous Substances Pollution Contingency Plan. The no further action alternative provides a comparative baseline against which other alternatives can be evaluated. Under Alternative 1, no further remedial action would be taken beyond the already completed TCRA in the Former Bryant Mill Pond and the IRMs (described in Section 1.3.2) implemented across OU1. The PCB-containing soils and residuals would be left in place, without the implementation of any further containment, removal, treatment, or other mitigating actions.

Natural attenuation processes would continue; however, environmental media within OU1 would not be monitored to assess progress toward achieving the RAOs. Alternative 1 does not provide for any active or passive institutional controls to reduce the potential for exposure (for example, physical barriers and ~~deed restrictions~~restrictive~~restrictions~~restrictiverestrictive covenants), nor does it address the existing potential risks to humans and ecological receptors associated with OU1.

5.1.1 Overall Protection of Human Health and the Environment

Under Alternative 1, the existing engineered cap over the Bryant HRDLs/FRDLs would not be inspected or maintained, the sheet pile along the western bank of Portage Creek would not be maintained, the groundwater collection and treatment system would not be run, and no institutional controls would be recorded to restrict access to OU1 or prevent the use of groundwater. The potential for exposure to materials with concentrations exceeding applicable PRGs would remain.

Current conditions at OU1 are generally stable relative to the ongoing potential for migration of COCs, and many source areas have been addressed; however, Alternative 1 provides no improved protection over the current conditions, provides no additional risk reduction, and is not expected to be protective of human health and the environment over the long term. The TCRA and IRMs completed to date have substantially satisfied the RAOs, but current exposure and potential risks in the outlying areas and portions of OU1 where IRMs have not been implemented would persist. Risks would likely increase over time if material exceeding OU1 PRGs in the uncapped disposal areas (such as, Monarch HRDL, Former Type III Landfill, and Western Disposal Area) became exposed and eroded into Portage Creek, the sheet pile wall failed, or the engineered cap was compromised and materials that are currently isolated/contained were exposed or released.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Since no active remedial efforts are proposed under Alternative 1, most of the action- and location-specific ARARs do not apply. The following specific ARARs would not be achieved if Alternative 1 were selected:

- **Part 201, Environmental Remediation, of NREPA, 1994 PA 451, as amended (Part 201).** This state ARAR establishes the identification, risk assessment, evaluation, and remediation of contaminated sites within the state. It establishes generic cleanup criteria and allows development of additional site-specific criteria to protect the environment, considering ecological risks (Section 20120(a)(17)).

  Alternative 1 would not reduce exposure or associated risk and would not achieve a degree of protectiveness for the property, as required in Part 201, Sections 20120a and 20120b. The potential for exposure to COC-containing residuals/soils and the potential migration of COC-contaminated material would still exist. Alternative 1 would not satisfy the requirements for long-term monitoring, achieve the requirement to restrict future land use, nor comply with Part 201 if transport of COCs to surface water occurs.

- **Part 31, Water Resources Protection, of NREPA, 1994 PA 451, as amended (Part 31).** This state ARAR establishes state criteria for rivers, creeks, and floodplain areas, to protect aquatic life and human health. It also establishes water quality standards and monitoring requirements for discharge effluents, including stormwater and venting groundwater, specifying standards for several water quality parameters, including COCs. Alternative 1 would not prevent stormwater or venting groundwater discharges to Portage Creek.

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~~5.1.3~~TSCA 40 C.F.R. § 761.61. TSCA regulations found at 40 C.F.R. § 761.61 provide cleanup and disposal and disposal options for PCB remediation waste. Alternative 1 would not achieve this ARAR because no action would pose an unreasonable risk of injury to health or the environment under 40 C.F.R. § 761.61(c).

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5.1.3 Long-term Effectiveness and Permanence

Implementation of Alternative 1 would not achieve RAOs 1, 2, or, 3, and would not provide or maintain protection of human health or the environment over the long term. The potential for exposure to COCs in areas where IRMs have not been implemented would remain, and the potential for the long-term effectiveness of the existing engineered cap and sheet pile to be compromised would increase over time if the current inspection and maintenance program were discontinued. As a result, the potential for unacceptable long-term risks to human health and the environment would remain.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Implementation of Alternative 1 does not include any active remedial components. Therefore, it does not address the federal statutory preference for a remedy that employs treatment technologies that permanently and significantly reduce the mobility, toxicity, or volume of COC-containing materials through treatment.

5.1.5 Short-term Effectiveness

No active remedial measures are proposed as part of Alternative 1; therefore, no potential short-term adverse impacts associated with construction or implementation of Alternative 1 exist. However, existing measures controlling access to OU1 would not be maintained, potentially increasing the risk of dermal exposure over the short term if individuals trespassed onto the property and contacted surficial materials containing COCs.

5.1.6 Implementability

Alternative 1 would be both technically and administratively implementable because no active remediation would occur. No equipment or specialized services would be required to implement the alternative, and no specific approvals would be necessary.

5.1.7 Cost

No capital or O&M costs are associated with the selection of Alternative 1. However, costs for 5 year reviews are included for a total cost of $54,000 as shown in Table 5-1.

5.2 Alternative 2—Consolidation and Capping

The primary element of Alternative 2 is the consolidation and capping of contaminated material into the existing landfills. Three alternatives were considered to present options for addressing the Outlying Areas within OU1. Alternative 2A includes the consolidation of Outlying Areas within OU1 and perimeter areas into the Bryant HRDLs/FRDLs and Monarch HRDL. Approximately 320,000 yd^3 of contaminated materials will be excavated in Alternative 2A, plus an additional 75,000 yd^3 to create a clean setback from Portage Creek. Alternative 2A is shown in Figure 2A.

Alternative 2B includes the consolidation of the Outlying Areas located within OU1, the Monarch HRDL and the perimeter area around the Bryant HRDLs/FRDLs into the Bryant HRDLs/FRDLs Landfill. Approximately 500,000 yd^3 of contaminated materials will be excavated in Alternative 2B, plus an additional 50,000 yd^3 to create a clean setback from Portage Creek. Alternative 2B is shown in Figure 4-2B.

Alternative 2C includes the consolidation of materials with PCB concentrations of 500 mg/kg or less from the Outlying Areas located within OU1, the Monarch HRDL, and the perimeter area around the Bryant HRDLs/FRDLs into the Bryant HRDLs/FRDLs Landfill. An estimated total 550,000 yd^3 of contaminated material will be excavated in Alternative 2C, including 50,000 yd^3 to create a clean set back from Portage Creek. Excavated materials with PCB concentrations greater than 500 mg/kg will be transported offsite for incineration. Of the 550,000 yd^3, an

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estimated 15,000 yd^3 of material will contain PCB concentrations above 500 mg/kg and will be transported offsite for incineration. The remaining 535,000 yd^3 of material will be consolidated into the Bryant HRDLs/FRDLs Landfill and capped. Alternative 2C is shown with Alternative 2B in Figure 4-2B.

The Alternative 2 options include covering the landfills after consolidation with an engineered landfill cap. For Alternative 2A, the landfill cap will be approximately 35 acres, and for Alternatives 2B and 2C, the landfill cap will be approximately 27 acres. The approach would also include long-term inspections and maintenance of the engineered barriers, monitoring of landfill gas and groundwater, and institutional controls. Groundwater monitoring implementation and costs are included in the assessment for implementing Alternative 2 options. The Alternative 2 options can include groundwater subalternatives for collection and treatment. Groundwater collection and treatment and slurry wall installation and costs are assessed separately in Section 5.3.

Alternative 2 options require institutional controls to restrict activities that could either damage the remedy or allow for exposure to contaminated material left in place (example, under buildings). At the OU1 property, restrictive covenants~~deed restrictions~~covenants, prohibiting the installation of drinking water wells and preventing activities that could compromise the landfill cap would be required. If contaminated material from OU1 is left in place at Outlying Areas, institutional controls in the form of restrictive covenants ~~deed restrictions~~ would be required to prohibit activities that would cause exposure to contaminated material.

5.2.1 Overall Protection of Human Health and the Environment

Alternative 2 options are expected to be effective remedies for protection of human health and the environment. The Alternative 2 options would achieve RAO 1 by mitigating the potential for human and ecological exposure to materials containing COCs above the relevant PRGs. Implementation of Alternative 2 options would also achieve RAO 2, since materials with COC concentrations above relevant PRGs would be covered with an engineered cap. The cap will mitigate the potential for migration to Portage Creek or onto adjacent properties by erosion. Alternative 2 options will achieve RAO 3 by preventing surface water infiltration through the waste. In order to confirm that RAO 3 has been achieved, a long-term groundwater monitoring program would be implemented. Institutional controls, monitoring, and maintenance of the Bryant HRDLs/FRDLs Landfills are critical components for maintaining protectiveness over time.

Alternative 2 would also include a long-term inspection and maintenance program of the Bryant HRDLs/FRDLs and, if implemented under Alternative 2A, the Monarch HRDL. The alternative also includes a long-term monitoring program for the management of landfill gas. Groundwater monitoring and subalternatives for groundwater collection and treatment and installation of a slurry wall are evaluated in Section 5.3. Groundwater monitoring and long-term inspection and maintenance activities would be conducted to assess whether the remedy is functioning as intended and to ensure that GSI criteria are met.

Alternative 2C is slightly more protective of human health and the environment since some of the highest concentration materials are removed from the site. However, the exposure pathways for the wastes is incomplete under all three of the Alternative 2 options, meeting the RAOs. Overall protection of human health and the environment is expected to be achieved upon completion of the consolidation activities and installation of the engineered cap (anticipated to take 2 years).

5.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 2 would achieve ARARs. Specific ARARs are summarized as follows:

- **Clean Water Act**. ~~This ARAR~~ Section 404 of the Clean Water Act applies to the discharge of dredge and fill material into the waters of the United States, including wetlands. Superfund policy is to require a minimum of one acre of wetlands mitigation for each acre of wetland filled. (See "Considering Wetlands at CERCLA Sites" OSWER 9280.0-03). Alternative 2 will comply with the Federal Mitigation Rule set forth at *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* 40 C.F.R. § 230.94(c)(2-14) because at least one acre of wetlands will be mitigated for each acre of wetland filled and a restrictive covenant will be implemented to maintain the wetland area. Alternative 2 will achieve this ARAR. ~~Alternative 2 includes erosion control~~

~~measures to meet this ARAR. Alternative 2 can include groundwater subalternatives that address discharges through treatment.~~

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- **Part 201, Environmental Remediation, of NREPA, 1994 PA 451, as amended (Part 201).** Alternative 2 would reduce the potential for exposure to COC-containing residuals/soils, address the potential migration of COC-contaminated material, and achieve a degree of protectiveness for the property, as required in Part 201, Sections 20120a, 20120b and 20120e. Groundwater monitoring data (2003) showed that groundwater was below generic groundwater/surface water interface (GSI)criteria under MCL 324.20120e between the waste management boundary and Portage Creek. Alternative 2 requires installation of additional groundwater monitoring wells to demonstrate compliance with GSI criteria at and near Portage Creek under MCl 324.20120e. Alternative 2 would satisfy the requirements for long-term monitoring and achieve the requirement to restrict future land use.

- **Part 31, Water Resources Protection of NREPA, 1994, PA 451, as amended (Part 31).** In accordance with the federal Water Pollution Control Act and the federal Clean Water Act, this state ARAR establishes state criteria for rivers, creeks, and floodplain areas, to protect aquatic life and human health. It also establishes water quality standards and monitoring requirements for discharge effluents including stormwater and venting groundwater, specifying standards for several water quality parameters, including COCs. ~~Under~~ Alternative 2 is required to meet the GSI requirements for venting groundwater under MCL 324.20120e (as discussed above), and thus is expected to meet the groundwater venting requirements for Part 31. , ~~consolidation and isolation of COC-contaminated materials beneath an engineered cap, combined with erosion control measures, would satisfy this ARAR~~.

- **Part 55, Air Pollution Control, of NREPA (Part 55).** This state ARAR establishes the requirements for air emissions. Current COC emissions are within acceptable limits. Excavation of COC-containing materials and disturbance of the current landfill surfaces and perimeters during construction could result in increased air emissions. Therefore, best management practices should be implemented to minimize airborne emissions during construction and remedy implementation to mitigate unacceptable air emissions. A health and safety plan would be developed to monitor emissions, prevent worker and community exposure, and confirm compliance with this ARAR.

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- **Michigan Public Act 451, Part 303—Wetlands Protection.** This ARAR establishes rules regarding wetland uses. Alternative 2 is anticipated to ~~can~~ comply with this ARAR ~~by employing proper construction and design techniques, including best management practices during the removal of impacted material near the Panelyte Marsh~~.

- **Part 91, Soil Erosion and Sedimentation Control of NREPA, 1994 PA 451, as amended (Part 91).** This ARAR establishes requirements to minimize soil erosion and sedimentation. The ARAR requires that an "earth change" (excavation, filling, or grading) be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time, as determined by the local enforcing agency. It also requires the design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a non-erosive velocity. The ARAR requires installation and maintenance of temporary silt fences or other structures as necessary to minimize erosion and sedimentation during construction activities. Alternative 2 will comply with this ARAR by preparing and properly implementing a soil erosion and sedimentation control plan in accordance with Part 91.

- **TSCA, 40 CFR § 761.61.** This ARAR applies to the cleanup and ~~the~~ disposal of PCB Remediation Waste. ~~Once waste is excavated for consolidation and capping, the TSCA regulations would be in effect.~~ Alternative 2 meets the standards of 40 C.F.R. § 761.50(b)(3)(i)(A) for remediation and will not pose an unreasonable risk of injury to health or the environment pursuant to 40 C.F.R. § 761.61(c) for the following reasons: a) These alternatives will meet the PRGs set forth in Table 2-3 for surface soils, subsurface soils, sediments and groundwater. The PRG cleanup levels meet or exceed a risk of , which is- protective of human health and the environment; b) the cap

Commented [JC41]: The rationale needs to be in the FS – so the public will have an opportunity to comment on it.

will be constructed over the landfill to eliminate direct contact hazards. The cap will also minimize infiltration of precipitation through the landfill, and prevent migration of residuals or leachate from the landfill into the adjacent areas. See discussion under 5.2.1 and 5.2.3 concerning how the cap will achieve RAOs and be effective over the long term. The cap is equivalent to or exceeds the cap requirements set forth in 40 C.F.R. § 761.61(b)(7) and by reference 40 C.F.R. §761.75(b)(ii) through (v). For example, the cover system will have a 30-millimeter polyvinyl chloride FML or equivalent (permeability less than 10-10 cm/sec), which exceeds the 10-7 permeability requirement of 40 C.F.R § 761.61(7) and by reference 40 C.F.R. 761.75(b)(ii). Need discussion on ~~includes onsite disposal of PCB Remediation Waste. USEPA would apply for the risk-based method for closure of PCB remediation waste under 40 CFR § 761.61(c).~~ Alternative 2C would also use a TSCA-permitted incineration facility.

- Michigan Public Act 451, Part 115 – Solid Waste Management: The Part 115 rules promulgated for the cover design, groundwater monitoring, hydrogeologic monitoring and construction quality control requirements for a Type III sanitary landfill would be relevant and appropriate for those alternatives that cap material in place at OU1.

Commented [JC42]: Please discuss either how the cap will be equivalent to or otherwise meet the precent soil passing No. 200 sieve, liquid limit and plasticity index requirements of 761.75(b)(ii) through (v).

BJR: 761.75(b)(ii) through (v) are siting requirements, not cap requirements.

Commented [JC43]: Please discuss how the alternative will alternative 2 will meet the requirements identified in MI ARAR letter.

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5.2.3 Long-term Effectiveness and Permanence

Implementation of Alternative 2 would generally be expected to achieve the RAOs for OU1, be effective over the long term, and maintain protection of human health and the environment after the after the remedial action has been completed. Isolation of COC-containing materials under an engineered cap is a proven and reliable technology to prevent human and ecological exposure. Capping would mitigate the potential for direct contact and COC-containing materials to migrate by air emissions, wind-blown particles, erosion, or surface water runoff into Portage Creek or onto adjacent properties, RAOs 1 and 2. Capping would minimize infiltration through the waste, reducing potential impacts to groundwater and surface water, RAO 3. Implementation of institutional controls, long-term monitoring, and maintenance would allow for the long-term effectiveness and permanence of the engineered cap. The potential for failure of the engineered cap is low, a clean setback and stabilized stream banks will reduce the potential for Portage Creek to erode into the landfill. O&M activities would effectively identify future maintenance needs, and institutional controls would prohibit activities that could damage the cap. Future use of OU1 and potential long-term reuse issues would be addressed through monitoring and institutional controls, including restrictive ~~covenants~~~~deed restrictions~~covenants, and access restrictions, such as signage and fencing. The details of long-term monitoring and maintenance would be developed during remedial design and compiled into an O&M program. Groundwater monitoring and collection and treatment subalternatives are evaluated in Section 5.3.

Alternative 2, along with effective implementation of institutional controls, would effectively reduce risks over the long term, and the monitoring components would provide mechanisms to assess whether the remedy is performing in a manner that satisfies the RAOs over time. The treatment component to Alternative 2C does not increase protectiveness as the PCBs are largely immobile already.

Alternatives 2B and 2C provide a smaller footprint for the remaining landfill areas than Alternative 2A. A smaller footprint decreases the area requiring O&M and reduces the number of monitoring well locations needed for monitoring.

Alternative 2 would allow for redevelopment, both commercial and recreational in the area away from the landfill. Limited reuse scenarios are also possible on the landfill itself. Relocation of the Monarch HRDL could open an additional 6.8 acres to recreational use in the floodplain.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2A and 2B use containment to reduce the mobility of COC-containing materials without treatment. Alternative 2C also uses treatment for excavated soils with PCB concentrations above 500 mg/kg. Treatment is most important for COCs that are mobile in the environment. As discussed in the RI report and summarized in Sections 1.5.1 and 2.3.1 of this report, PCBs tend to be relatively immobile in the environment, and at OU1 are most prone to migration where they are exposed to erosion. Based on the combined effects of high affinity for PCBs to adhere to the residual and the low hydraulic conductivity, it is understood that PCBs do not migrate significantly from the residual material. Treatment to reduce mobility would be of little benefit since PCB concentrations in groundwater do not exceed criteria with the exception wells screened within or immediately adjacent to the residuals. Treatment to reduce mobility would likely cause a significant increase in volume of waste due to the addition of solidifying agents. As a result, the isolation of PCB-containing materials in place through consolidation beneath an engineered cap is expected to effectively address the mobility of PCBs and other COCs associated with potential migration by erosion. Alternative 2C is the only option that provides a reduction in the volume or toxicity of COC-containing materials.

5.2.5 Short-term Effectiveness

Alternative 2 provides an acceptable degree of short-term effectiveness. There is the potential for a short-term increase in COC exposure to workers due to potential disturbance of COC-containing residuals as part of site preparation and implementation of the alternative; however, compliance with dust control procedures (appropriately wetting materials) and proper health and safety procedures (for example, monitoring and use of personal protective equipment as described in a health and safety plan) to be developed during remedial design would effectively mitigate the short-term impacts and protect onsite workers from hazards during construction (for example, working around heavy equipment).

The primary short-term impacts to the community include increased noise, the potential for dust-borne releases, and increased traffic. The potential for noise issues and dust-borne releases is most significant with the implementation of Alternative 2C since that alternative includes the additional work of the excavation of the Monarch HRDL along with the offsite properties and the characterization and segregation of materials over 500 mg/kg for offsite transport and incineration. In Alternative 2A, the Monarch HRDL would be capped in place and would not be consolidated into the Bryant HRDLs/FRDLs, Western Disposal Area, and Former Type III Landfill. After excavation and consolidation, truck traffic in local residential neighborhoods would increase throughout the duration of the project, since materials for the engineered cap would be hauled to OU1. Under Alternative 2 options, materials excavated from the offsite outlying areas would be trucked to the Bryant HRDLs/FRDLs and/or Monarch HRDL, and clean fill would be hauled in to fill the excavations. An estimated 22,000 truck trips are estimated to implement Alternative 2A while over 30,000 truck trips are estimated to implement Alternative 2B. Alternative 2C also incurs increased short-term risks associated with offsite transport. It is anticipated that an additional 900 truck trips are required to haul the most highly contaminated materials approximately 40 miles to an intermodal facility where they would be loaded onto rail for transport to the incineration facility. The number of TSCA-permitted incinerators is very limited, so the rail transport could be 1,200 miles or more.

Commented [MB44]: And additional risks by just having a longer field work period.

The removal of materials beneath the Alcott Street and Goodwill parking lots would have significant short-term impacts to neighboring properties/property owners. The excavations at these locations may reach 15 to 20 feet below grade or more, and are expected to require benching and/or sheet pile to allow removal to target depths. The installation and removal of sheet pile will create noise and cause vibrations in the immediate area during the period of construction, potentially disturbing nearby property owners/occupants. Additional short-term environmental impacts are associated with the potential for offsite migration due to dust-borne releases or incidental releases to Portage Creek. The dust-borne releases could be readily mitigated by keeping the excavation/consolidation areas/materials appropriately wet.

Reasonable and appropriate controls (for example, silt curtains) would be implemented when removing materials that lie close to Portage Creek and wetland areas of OU1 to mitigate impacts to the aquatic environment. Areas disturbed during implementation would be restored after construction with appropriate native plantings (or restored as wetland areas, if appropriate). The estimated duration to complete Alternative 2 is approximately 2 years. The installation of the engineered caps would be conducted during the standard Michigan construction season, which is typically early April through the end of October, weather-dependent.

5.2.6 Implementability

Implementation of Alternative 2 includes the following major components: excavation and consolidation, construction of engineered caps, installation of a stormwater management system, landfill gas monitoring, restoration, and O&M activities, groundwater monitoring, and the implementation of institutional controls. Groundwater collection and treatment or slurry wall installation are considered as subalternatives to groundwater monitoring and are evaluated in Section 5.3. The process options incorporated into this alternative are proven remedial options and have been implemented successfully on environmental cleanup projects throughout the country. Technologies for the installations of engineered caps are well-established, widely applied, and are proven to be reliable over long periods of time at sites of similar size and characteristics.

The excavation depths of the Outlying Areas are more complicated than the periphery of the Bryant HRDLs/FRDLs and/or Monarch HRDLs. Excavations at the Alcott Street and Goodwill parking lots could extend as deep as 15 to 20 feet below the ground surface. Given this depth and the adjacent buildings, the excavations would need to be stabilized with temporary steel sheeting. Special implementation methods will be required to drive the sheets while minimizing the potential for damage to the adjacent structure, for example, trenching and predrilling, and pile driving using low vibratory methods may be used to minimize impacts. Crack, vibration, and settlement monitoring will be required to verify sheet pile installation is not causing damage to adjacent properties.

Excavating to a depth of 15 to 20 feet below the ground surface significantly increases the likelihood of encountering groundwater—as a result, supplemental engineering controls would be necessary to manage groundwater in the saturated fill. Such engineering controls would likely include a combination of excavation reinforcement (such as sheeting), dewatering, and soil stabilization. If a significant head differential exists between the groundwater table and the base of the excavation, a potential for creating hydrostatic pressure at the base of the excavation exists. Concerns relating to hydrostatic pressure may be minimized through engineering controls such as lengthening the flow path (for example, if sheeting is used, increasing the embedment depth) and installing piezometers for monitoring vertical hydraulic gradients. While such groundwater management measures will present additional design and construction challenges, they are technically feasible and implementable. The offsite excavations are assumed to be completed with conventional earth moving equipment. The periphery excavation and consolidation activities at the Bryant HRDLs/FRDLs and/or Monarch HRDLs are also implementable using conventional earth-moving equipment. Dewatering and erosion and sedimentation controls, such as silt fence, would also be required around wetland areas.

Support services and sufficient quantities of construction materials are expected to be readily available, and qualified commercial contractors are available locally to perform the work. Since OU1 is part of a CERCLA site, permits are not required for onsite activities; however, meeting the substantive applicable requirements of federal and state regulations is required.

Alternative 2C is the least implementable due to the limited number of TSCA-permitted incinerators. With an estimated 15,000 yd^3 of material and a minimum transport distance of approximately 1,200 miles to a TSCA-permitted incinerator, trucking is not a feasible alternative. The wastes would likely need to be loaded into intermodal roll-off containers, transported by truck to an intermodal transfer facility, and transferred to rail.

Implementation of a site-wide groundwater monitoring program requires the installation of monitoring wells and sampling. Site-wide monitoring programs have been implemented successfully on cleanup projects throughout the Kalamazoo River OUs and across the country.

Institutional controls at the OU1 property should be easily implemented by Lyondell, the bankruptcy Trustee. It will likely be more challenging to implement institutional controls at the Goodwill property; however, they are implementable as evidenced by the existing institutional controls there.

5.2.7 Cost

Costs for Alternative 2 are associated with the following construction activities: project-area preparation, excavation and consolidation, installation of the engineered cap, stormwater management, restoration, and long-term monitoring and maintenance. Costs for Alternative 2 include groundwater monitoring in the base remedy cost.

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The estimated costs associated with the implementation of Alternatives 2A, 2B, and 2C are presented in Tables 5-2, 5-3, and 5-4, respectively.

The total estimated capital cost of implementing Alternative 2A is $36 million, and the total estimated O&M cost is $4 million. The total estimated periodic cost for 5-year reviews is $54,000. The total estimated 30-year present-worth cost associated with implementation of Alternative 2A is $40 million.

The total estimated capital cost of implementation of Alternative 2B is $36 million, and the total estimated O&M cost is $3 million. The total estimated periodic cost for 5-year reviews is $54,000. The total estimated 30-year present-worth cost associated with implementation of Alternative 2B is $39 million.

The total estimated capital cost of implementation of Alternative 2C is $57 million, and the estimated O&M cost is $3 million. The total estimated periodic cost for 5-year reviews is $54,000. The total estimated 30-year present-worth cost associated with implementation of Alternative 2C is $60 million.

The total costs for Alternatives 2A and 2B are similar, $40 million versus $39 million. While Alternative 2B requires excavation of an additional 180,000 yd^3 of contaminated soil and residuals, the cost is offset by the smaller area requiring capping in Alternative 2B versus 2A. Alternative 2C is significantly increased (total of $60 million) as a result of the offsite transportation and incineration of 15,000 yd^3 of material.

5.3 Alternative 2—Subalternatives (i) and (ii)

Groundwater monitoring is included in Alternative 2 options. The purpose of the monitoring program will be to monitor the performance of the remedy and to allow for the ongoing evaluation of whether Alternative 2 options meet RAO 3.

The primary elements of the groundwater subalternatives are: (i) groundwater collection and treatment for the hydraulic containment and control of impacted groundwater within OU1, and (ii) containment through installation of a ground slurry wall (approximately 3,000 linear feet) around the perimeter of the Bryant HRDLs/FRDLs, and under Alternative 2A, the Monarch HRDL, along with hydraulic containment/control assessed.

5.3.1 Overall Protection of Human Health and the Environment

Groundwater monitoring will be used to verify the capping remedies are performing as expected, minimizing surface water infiltration, and that the COC-contaminated material at OU1 is not impacting groundwater, causing groundwater with concentrations exceeding the PRGs to migrate to Portage Creek. Monitoring is included as a component of Alternative 2 options. Alternative 2 will achieve RAO 3 by preventing surface water infiltration through the waste. The groundwater monitoring program monitors the performance of the remedy and compliance with RAO 3.

Subalternative (i), groundwater collection and treatment, and subalternative (ii), slurry wall with groundwater collection and treatment, are both expected to be effective remedies for the protection of human health and the environment from impacted groundwater by reducing the potential for PCB-contaminated material from impacting groundwater or surface water that migrates into Portage Creek or onto offsite properties.

The use of only subalternative (i) is expected to achieve RAO 3 through the collection and treatment of groundwater that may be impacted by COC-containing material at OU1. The use of subalternative (ii), slurry wall with groundwater collection and treatment, will allow for groundwater gradients to be manipulated, reversing groundwater flow from Portage Creek toward the fill area.

5.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

Groundwater subalternatives (i) and (ii) would be implemented in conjunction with Alternative 2 options if needed; therefore, they would achieve the ARARs summarized in Section 5.2.2.

5.3.3 Long-term Effectiveness and Permanence

Provided that they are maintained, implementation of groundwater subalternatives (i) and (ii) would generally be expected to achieve the RAO 3 for OU1. Both subalternatives would be effective over the long term, and would maintain protection of human health and the environment after the RAOs have been achieved. Hydraulic containment is a proven and reliable technology to prevent human and ecological exposure by capturing impacted groundwater before migrating offsite.

The long-term effectiveness of the cap and/or hydraulic containment contingencies would be evaluated through the long-term monitoring program implemented under Alternative 2 options. With proper maintenance, the potential for failure of the hydraulic containment or isolation and hydraulic containment contingencies is low. Currently, a sheet pile wall exists along a portion of the Bryant HRDLs/FRDLs, and a groundwater collection system is currently in place to maintain historic water levels at OU1.

Subalternative (i), groundwater collection and treatment, could be abandoned simply if monitoring indicated that hydraulic containment was no longer needed. Subalternative (ii), construction of a slurry wall, is expected to cause groundwater mounding upgradient of its location. This would require the hydraulic controls be operated as long as the isolation wall is in place. Removal of the slurry wall is an expensive undertaking in the post-closure period. It should be noted that the existing sheet pile wall is identified for removal or modification in this and other alternatives to allow for groundwater flow to the creek. The use of subalternative (ii) would reestablish an impermeable barrier that is proposed for removal in most alternatives.

Installation of the slurry wall under subalternative (ii) may create long-term issues. One of the reasons for the removal of the sheet pile wall is to create natural groundwater flow towards the creek. Installation of a slurry wall downgradient from the landfills towards the creek would again create an impermeable barrier. The barrier would create mounding of groundwater underneath the landfill and cause the creation of preferential pathways for the groundwater around the slurry wall along the edges of the system without groundwater collection and treatment.

The details of long-term monitoring and maintenance for subalternatives (i) and (ii) would be developed during remedial design and compiled into an O&M program. Groundwater treatment subalternatives (i) and (ii) would effectively reduce the risk of offsite impacted groundwater migration over the long term, and the monitoring component would provide a mechanism to assess whether the contingencies are performing in a manner that satisfies RAO 3 over time.

5.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Subalternatives (i) and (ii) address the federal statutory preference for a remedy that employ treatment technologies by providing treatment to limited amounts of groundwater prior to discharge. The treatment reduces the volume of COCs in groundwater, if present. The hydraulic containment system would include treatment of extracted groundwater prior to discharge, thereby reducing the volume of COCs, if present in the groundwater.

5.3.5 Short-term Effectiveness

Minimal exposure is associated with the installation and later sampling of groundwater wells for monitoring. Operation of the groundwater collection and treatment system will also provide an acceptable degree of short-term effectiveness. Minimal exposure is associated with the operation of the system. Some disturbance of waste could be expected during well or trench installation. There is a greater potential of short-term exposure risk to workers due to potential disturbance of impacted residuals as part of installation of a hydraulic containment system around the landfills.

Soil and groundwater management and proper health and safety procedures (for example, monitoring and use of personal protective equipment as described in the health and safety plan) to be developed during remedial design would effectively mitigate the short-term impacts and protect onsite workers from exposure to hazards during construction associated with either of the subalternatives.

The primary short-term impacts from implementation of groundwater treatment subalternatives (i) and (ii) to the community include increased noise and increased traffic. Truck traffic in local residential neighborhoods would increase throughout the duration of the project, since materials for the additional groundwater treatment system and, if selected, slurry wall (ii), would be hauled to OU1. Additional short-term environmental impacts are associated with the potential for offsite migration due to incidental releases to Portage Creek during installation of the additional hydraulic containment system or slurry wall. Reasonable and appropriate controls (for example, silt curtains) would be implemented when removing materials that lie close to Portage Creek and wetland areas of the Bryant HRDL, Panelyte Marsh and Former Monarch Raceway Channel to mitigate impacts to the aquatic environment. Areas disturbed during implementation would be restored after construction with appropriate native plantings (or restored as wetland areas, if appropriate). The estimated duration to complete groundwater monitoring is included in Alternative 2 options. The estimated duration to complete subalternative (i) is 2 months, and subalternative (ii) is 4 months.

5.3.6 Implementability

The groundwater collection and treatment subalternative (i) includes the following component: installation of extraction wells and/or collection trenches at the Bryant HRDLs/FRDLs and, if Alternative 2A is selected, Monarch HRDL. O&M of the groundwater treatment system would be necessary if subalternative (i) was implemented as part of any Alternative 2 option.

Implementation of subalternative (ii) would include the following components: installation of a slurry wall around the Bryant HRDLs/FRDLs and, if Alternative 2A is selected, Monarch HRDLs; installation of extraction wells and/or collection trenches to prevent groundwater mounding; O&M of the groundwater collection and treatment system; and long-term maintenance and monitoring of the slurry wall.

The process options incorporated into the groundwater subalternatives (i) and (ii) are proven remedial technologies and have been implemented successfully on environmental cleanup projects throughout the country. Groundwater monitoring planned under Alternative 2 options would continue with either subalternative to verify the system is performing as designed.

Installation of the slurry wall under subalternative (ii) may create long-term issues. One of the reasons for the removal of the sheet pile wall under this and other alternatives is to create natural groundwater flow towards the creek. Installation of a slurry wall downgradient from the landfills towards the creek would again create an impermeable barrier. The barrier would create mounding of groundwater underneath the landfill and cause the creation of preferential pathways for the groundwater around the slurry wall along the edges of the system if the groundwater collection and treatment system were shut down.

Support services and sufficient quantities of construction materials are expected to be readily available for each of the subalternatives. Since OU1 is part of a CERCLA site, permits are not required for onsite activities; however, meeting the substantive applicable requirements of federal and state regulations is required.

5.3.7 Cost

Costs for groundwater monitoring are included in cost estimates for Alternative 2 options. Monitoring would be a required component of both subalternatives (i) and (ii) and would not change significantly if either of the groundwater subalternatives were selected.

The estimated costs associated with the implementation of subalternative (i) groundwater collection and treatment and (ii) slurry wall installation for Alternative 2A are presented in Tables 5-5 and 5-6, respectively.

The total estimated capital cost of implementing subalternative (i) for Alternative 2A is $1.6 million, and the total estimated O&M cost is $1.5 million. The total estimated 30-year present-worth cost associated with implementation of subalternative (i) for Alternative 2A is $3.1 million.

The total estimated capital cost of implementing subalternative (ii) for Alternative 2A is $10 million, and the total estimated O&M cost is $1.5 million. The total estimated 30-year present-worth cost associated with implementation of subalternative (ii) for Alternative 2A is $12 million.

The estimated costs associated with the implementation of subalternative (i) groundwater collection and treatment and (ii) slurry wall installation for Alternative 2B and 2C are presented in Tables 5-7 and 5-8, respectively.

If Alternative 2B or 2C is selected, the total estimated capital cost of implementing subalternative (i) is \$1.5 million, and the total estimated O&M cost is \$1.5 million. The total estimated 30-year present-worth cost associated with implementation of subalternative (i) for Alternative 2B or 2C is \$3 million.

The total estimated capital cost of implementing subalternative (ii) for Alternative 2B or 2C is \$8.6 million, and the total estimated O&M cost is \$1.5 million. The total estimated 30-year present-worth cost associated with implementation of subalternative (ii) for Alternative 2B or 2C is \$10 million.

5.4 Alternative 3—Total Removal and Offsite Disposal

Alternative 3 includes excavation and offsite disposal of materials exceeding PRGs for OU1 COCs. Materials would be excavated from the Former Operational Areas; the Bryant HRDLs/FRDLs; the areas that lie close to Portage Creek, the targeted portions of Panelyte Marsh, Panelyte Property, and Conrail Property; the offsite outlying areas other than the portion of the Goodwill property covered by buildings; and the areas in the periphery of the Former Operational Areas near adjacent properties (Figure 4-3). After removal, excavation areas would be backfilled with clean material, covered with topsoil, and revegetated with native plants and grasses. This alternative also includes the removal of 2,600 linear feet of sheet pile along the western bank of Portage Creek. No other O&M activities or institutional controls would be necessary.

It may not be possible to excavate all of the material at the Goodwill property. If, due to practicability, contaminated material from OU1 is left in place at Outlying Areas, institutional controls in the form of restrictive covenants~~deed restrictions~~covenants would be required to prohibit activities that would cause exposure to contaminated material. If material is left at the Goodwill property, a groundwater subalternative (Section 5.3) would be required. For the purposes of this evaluation, it is assumed that all material exceeding PRGs can be removed, and institutional controls and groundwater monitoring would not be required.

5.4.1 Overall Protection of Human Health and the Environment

Alternative 3 would be an effective long-term remedy for OU1—it would eliminate the potential for direct contact with materials onsite above PRGs. In the offsite outlying areas, the potential for human and ecological receptors to be exposed to materials containing COCs above the relevant PRGs would also be eliminated. There would be no materials above the OU1 PRGs to migrate into Portage Creek or onto offsite properties. The actions would be prevented through excavation and offsite disposal. Since no materials with COCs above OU1 PRGs would be left in place onsite, no monitoring or maintenance activities would be necessary to maintain protectiveness over time, unless material must be left in place below the Goodwill building; in which case, monitoring and maintenance would be required for that limited area.

Total removal would achieve RAO 1 by mitigating the potential for human and ecological exposure to materials containing COCs above the relevant PRGs, by excavation and offsite disposal. Implementation of Alternative 3 would also achieve RAO 2 since contaminated material would be removed from OU1, thus eliminating the potential for contaminated material to impact groundwater or surface water that migrates to Portage Creek or onto adjacent properties. The removal of materials with COC concentrations above the relevant PRGs would eliminate any issues with surface water infiltration and subsurface groundwater migration. Alternative 3 would achieve RAO 3 since the source material would be removed. Since the sources would be removed, there would be no need for a long-term groundwater monitoring program, unless material must be left in place below the Goodwill building.

Overall, protection of human health and the environment is expected to be achieved upon completion of the excavation and disposal activities (anticipated to take 5 years). There would be no need for institutional controls to be put in place to maintain effectiveness over time.

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5.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

~~ARARs that apply to Alternative 2 similarly apply to~~ Alternative 3 would achieve compliance ARARs as follows:

~~As with Alternative 2, the relevant ARARs would be achieved by the implementation of Alternative 3.~~ **Clean Water Act**: Section 404 of the Clean Water Act applies to the discharge of dredge and fill material into the waters of the United States, including wetlands. Superfund policy is to require a minimum of one acre of wetlands mitigation for each acre of wetland filled. (See "Considering Wetlands at CERCLA Sites" OSWER 9280.0-03). Alternative 2 will comply with the Federal Mitigation Rule set forth at *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* 40 C.F.R. § 230.94(c)(2-14) because at least one acre of wetlands will be mitigated for each acre of wetland filled and a restrictive covenant will be implemented to maintain the wetland area.

Part 201, Environmental Remediation, of NREPA, 1994 PA 451, as amended (Part 201). This alternative will meet the cleanup standards set forth in Part 201.

TSCA, 40 CFR § 761.61. This ARAR applies to the cleanup and disposal of PCB Remediation Waste. Alternative 3 meets the standards of 40 C.F.R. § 761.50(b)(3)(i)(A) for remediation and will not pose an unreasonable risk of injury to health or the environment pursuant to 40 C.F.R. § 761.61(c). The alternative will meet the PRGs set forth in Table 2-3 for surface soils, subsurface soils, sediments and groundwater. The PRG cleanup levels meet or exceed a risk of , which is protective of human health and the environment;

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5.4.3 Long-term Effectiveness and Permanence

The primary components incorporated into Alternative 3—excavation, offsite disposal, and immobilization—are proven and reliable, and would be expected to provide long-term protection of human health and the environment after the Remedial Action has been completed. After the construction phase is over, sources of COCs exceeding OU1 PRGs both onsite and in the offsite outlying areas will be permanently removed. The alternatives would eliminate the potential for source materials to migrate by air emissions, wind-blown particles, erosion, or surface water runoff into Portage Creek or onto adjacent properties. Stability of OU1 and outlying areas would be improved since the final surface would be graded to a stable repose, covered with topsoil, and vegetated with native plants and grasses.

Commented [JC45]: I didn't think this assumed removal of everything down to 1 ppm –we still have commercial restrictions and other "Common Elements" requirements?

~~There would be no need for institutional controls to restrict access to OU1.~~ A long-term monitoring and maintenance program to monitor the long-term effectiveness and permanence of the approach would also not be required since materials above OU1 PRGs have been removed offsite. There is no potential for failure of the remedy over the long term~~, and there would not likely be a need for restrictions on future use of OU1~~. The area would be available for redevelopment for either commercial or recreational use. Restrictive covenants would still be required to prohibit high occupancy of commercial areas.

Because all of the contaminated material would be removed from OU1 under Alternative 3, there would be no need to continue the groundwater monitoring program. The potential for groundwater exceeding applicable criteria to migrate to Portage Creek or offsite would be eliminated. The alternative also includes the removal of the existing sheet pile along the western bank of Portage Creek. As a result, there would be no risk of failure of the sheet pile or need for maintenance. Alternative 3 would effectively eliminate OU-related risks over the long term.

5.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 reduces the volume of contaminated soils onsite and the mobility by disposing of the materials in offsite disposal facilities. However, this option does not include treatment or result in overall reductions of toxicity, mobility, or volume of contaminated soils. For the FS, it has been assumed that the addition of a stabilizing agent will not be required to address free liquids prior to transport offsite.

5.4.5 Short-term Effectiveness

Implementation of Alternative 3 would present increased short-term risks due to issues associated with health risks to onsite workers, impacts to the community, duration of the project, and environmental impacts. The potential health risks to onsite remediation workers are due to short-term increases in COC exposure during site preparation and implementation (a result of either direct exposure or by dust-borne releases during excavation and handling of impacted materials). While this risk could be mitigated through the use of appropriate health and safety practices and by compliance with a health and safety plan, the volume of materials to be handled (1,600,000 yd^3) and the area of disturbance (a total of 52 acres) increase the chances of exposure. In addition, the number of work hours spent onsite around heavy equipment would be significant over a 5-year project, increasing the risk of an accident as compared to an option where fewer hours are spent in active construction activities.

The more significant short-term considerations associated with Alternative 3 are related to impacts to the community and the duration of those impacts—implementation is expected to take 5 years. There will be noise and increased traffic during implementation as well as potentially significant wear and tear on local roads. In addition, down-wind areas such as the residential properties may be subject to an increased potential for dust-borne releases. Excavation work is not confined to the warmer months, so excavation will be carried out year-round, 5 days per week. Over the course of the project, an average of between 30 and 40 trucks per day would travel in and out of OU1 over a 260-day work year (5 work days per week) to transport excavated material for offsite disposal and haul clean fill to the excavated areas. An estimated 120,000 truck trips to and from OU1 would be necessary to implement Alternative 3.

There would be short-term environmental impacts associated with the potential for offsite migration due to dust-borne releases or incidental releases to Portage Creek given that 52 acres will be disturbed during the implementation of Alternative 3. The dust-borne releases could be readily mitigated by keeping the excavation/consolidation areas/materials appropriately wet, but the size of the area being disturbed increases the risk nonetheless. Reasonable and appropriate controls (for example, silt curtains) would be implemented when removing materials that lie close to Portage Creek and wetland areas of OU1 to mitigate impacts to these environments.

The removal of materials exceeding OU1 PRGs beneath the Alcott Street and Goodwill parking lots would cause short-term impacts to neighboring properties/property owners. The excavations at the locations may reach 20 feet or more below grade, and are expected to require benching and/or sheet pile to allow removal to target depths. The installation and removal of sheet pile will create noise and cause vibrations in the immediate area during the period of construction, potentially disturbing nearby property owners/occupants. Areas disturbed during implementation would be restored after construction with appropriate native plantings (or restored as wetland areas, if appropriate), and the habitat in the impacted areas would be expected to recover quickly.

5.4.6 Implementability

Implementation of Alternative 3 includes the following major components: excavation, offsite disposal, and restoration. The components are proven and have been used successfully in numerous other environmental cleanup projects. Complete removal of materials containing COCs above the relevant PRGs is proven to be reliable. The disposal of impacted materials in a licensed disposal facility would likely present significant administrative challenges. There are a limited number of solid waste landfills in southwest Michigan. Where disposal facilities are available, they may have restrictions as to the rate at which they will accept waste material given the limitations of the size and configuration of their operations.

Further, among the available solid waste facilities there may be limited disposal capacity to place the PCB-containing materials. The TCRA completed at the former Plainwell Impoundment in Plainwell, Michigan, between 2007 and 2009 included the removal and offsite disposal of 130,000 yd^3 of PCB-containing soils and sediments at three solid waste landfills in the region—two were used for non-TSCA waste, and the third was used for TSCA waste. At the time of the TCRA, these were the only facilities in southwest Michigan that would accept the waste (and the nearest landfill that would accept TSCA waste was located in Detroit). Initially, just one landfill was identified for the non-TSCA waste, but during the first season of construction, that landfill temporarily stopped accepting waste. Removal activities were sometimes slowed and occasionally stopped while another landfill was identified and arrangements were made at the original facility to accommodate additional waste (ARCADIS 2009b).

The potential for restrictions in rate and capacity of waste disposal may significantly affect the timely completion of Alternative 3, given the large volume of material that would be disposed of offsite. It is also possible that there

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is insufficient collective disposal capacity at the nearby solid waste facilities and TSCA landfills for the 1,600,000 yd^3 of material contemplated for disposal. In that case, facilities outside of southwest Michigan would have to be considered, which would increase short-term risks since transport distances would be longer. Alternative 3 could be completed in 5 years assuming offsite disposal does not become a rate-limiting factor.

Excavation, offsite disposal, and restoration are implementable using readily available, conventional earth-moving equipment. The excavation of targeted offsite outlying areas is more complicated than the work proposed for the onsite areas, particularly given that parking lots will have to be removed to access soils in certain areas and buildings are in close proximity to the areas targeted for action. Excavations in the areas could extend as deep as 15 to 20 feet below the ground surface. Given this depth and the adjacent buildings, the excavations would need to be stabilized with temporary steel sheeting. Special implementation methods will also be required to drive the sheets while minimizing the potential for damage to the adjacent structure for example; trenching and predrilling, and pile driving using low vibratory methods may be required. In addition crack, vibration, and settlement monitoring will be required to identify any issues with adjacent property owners.

In addition, excavating to a depth of 15 to 20 feet below the ground surface significantly increases the likelihood of encountering groundwater—as a result, the same supplemental engineering controls described in the implementability section for Alternative 2 would be necessary in Alternative 3 to manage groundwater in the saturated fill. While the groundwater management measures will present additional design and construction challenges, they are technically feasible and implementable.

Given the 5-year timeframe associated with this alternative, it is possible that onsite management of the project would be transferred at some point during construction, and support staff—both in the field and the office—would also be subject to turnover. While this type of transition is manageable, it is an issue of implementability to consider. The sheet pile removal element of this alternative would also be a relatively straightforward effort. The necessary support equipment (a crane to hold the steel while it is being readied for removal) is readily available. Offsite transport and disposal of the sheet pile is not anticipated since the steel should be able to be salvaged or sold. Since OU1 is part of a CERCLA site, permits are not required for onsite activities; however, the substantive applicable requirements of federal and state regulations would need to be met.

5.4.7 Cost

Costs for Alternative 3 are associated with the following construction activities: project area preparation, excavation, offsite disposal, sheet pile removal, and restoration. The estimated cost associated with the implementation of Alternative 3 is presented in Table 5-9.

For Alternative 3, the total estimated capital cost of implementation is $366 million. The total estimated periodic cost for 5-year reviews is $54,000 in case any institutional controls are required. Since there is no O&M component, the total estimated 30-year present-worth cost associated with implementation of Alternative 3 is $366 million.

5.5 Alternative 4—Encapsulation Containment System

Alternative 4 includes the excavation of soil and/or sediment containing COCs above the relevant PRGs and disposal within a series of containment cells constructed onsite in the locations of the current Former Operational Areas. In Alternative 4, materials in the following areas would be excavated (Figure 4-4):

- Former Operational Areas
- Monarch HRDL
- Bryant HRDLs/FRDLs
- Areas that lie close to Portage Creek
- Targeted portions of Panelyte Marsh
- Panelyte property
- Conrail property
- Outlying Areas other than the portion of the Goodwill property covered by buildings
- Areas in the periphery of the Former Operational Areas near adjacent properties

The areas would be excavated sequentially, with materials stockpiled during cell construction. Since the bottom of each disposal cell would need to be a minimum of 10 feet above the water table in order for the liner to function in a fully protective manner, clean fill would be added to raise the bottom of the cell to the appropriate elevation after excavation is complete. The base liner would then be constructed as described in Section 4.5, approximately 75 percent of the materials excavated from the Former Operational Areas would be placed in the cell, and the final cover system would be constructed. The remaining 25 percent of the excavated materials (which would be volumetrically displaced by the clean fill, the base liner, and the cover system) would be transported offsite for disposal along with the materials excavated from the offsite outlying areas. The cell covers would be revegetated with native plants and grasses. Alternative 4 would also include long-term inspections and maintenance of the containment cells, monitoring of landfill gas and groundwater, and institutional controls.

5.5.1 Overall Protection of Human Health and the Environment

Alternative 4 would be an effective long-term remedy for OU1—it would eliminate the potential for direct contact with materials exceeding PRGs onsite and in the offsite outlying areas, eliminate the potential for human and ecological receptors to be exposed to materials containing COCs above the relevant PRGs, and eliminate the potential for contaminated materials to migrate into Portage Creek or onto offsite properties. This would be accomplished through excavation and onsite disposal in a series of containment cells, long-term monitoring and maintenance, and institutional controls. Since COCs would be left onsite, implementation of institutional controls and the monitoring and maintenance components of the remedy would be critical to maintaining protectiveness over time. This approach would achieve RAO 1 by mitigating the potential for human and ecological exposure to materials containing COCs above the relevant PRGs by isolation in the cells (and offsite disposal of materials displaced).

Implementation of Alternative 4 would also achieve RAO 2, since materials with COC concentrations above relevant PRGs left onsite would be encapsulated, thus eliminating the potential for migration to Portage Creek or onto adjacent properties. The complete liner system would mitigate any issues with the potential for contaminated material at OU1 from impacting groundwater or surface water and migrating to Portage Creek or offsite (RAO 3). The long-term groundwater monitoring program would be carried out to verify that groundwater conforms to the applicable risk-based standards. The long-term inspection and maintenance program for the newly constructed consolidation cells, along with the long-term landfill gas monitoring program, would further provide for protection of human health and the environment.

Overall protection of human health and the environment is expected to be achieved upon completion of the excavation/consolidation/disposal activities. It is anticipated that this remedy would take about 10 years to complete. Institutional controls would require maintenance of the disposal cells, which would provide for long-term protection of human health and environment.

5.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

ARARs that apply to Alternative 2 similarly apply to Alternative 4. The relevant ARARs would be achieved by the implementation of Alternative 4.

5.5.3 Long-term Effectiveness and Permanence

The primary components incorporated into Alternative 4—excavation, construction of a series of containment cells, consolidation, and offsite disposal—are proven and reliable. Alternative 4 would be expected to provide long-term protection of human health and the environment after the RAOs have been achieved. The disposal cells would be constructed with two impermeable engineered barriers—one above and one below the contained materials, which is a proven and effective method of isolating and eliminating potential contact with contaminated materials. The cells would mitigate the potential for COC-containing materials to migrate by air emissions, wind-blown particles, erosion or surface water runoff, into Portage Creek or onto adjacent properties.

Stability of OU1 and outlying areas would be improved as the entire property would be graded to a stable repose as part of the construction of the cells. Implementation of institutional controls and long-term monitoring and maintenance would provide for the long-term effectiveness and permanence of the disposal cells. The potential

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for failure of the impermeable barriers used to construct the cells is low, as O&M activities would effectively identify future maintenance needs. Future use of OU1 and potential long-term issues would be addressed through monitoring and institutional controls, including ~~deed restrictions~~restrictive covenants, signage, and fencing. The details of long-term monitoring and maintenance would be developed during remedial design and compiled into an O&M program. Implementation of a long-term groundwater monitoring program would confirm that Alternative 4 achieves RAO 3, mitigating the potential for contaminated material to impact groundwater or surface water migrating to Portage Creek or offsite.

Alternative 4 also includes the removal of the existing sheet pile along the western bank of Portage Creek. As a result, there would be no risk of failure of the sheet pile or need for maintenance. Alternative 4 would effectively reduce risks over the long term, and the monitoring components and institutional controls would provide mechanisms to verify the remedy is performing as anticipated over time.

Due to the larger footprint of the encapsulation system less area around the landfill would be available for redevelopment.

5.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 uses containment to reduce the mobility of COC-containing materials without treatment. Placement of contaminated materials within fully encapsulated containment cells reduces mobility of COCs and exposure potential by isolation. The toxicity of the material would not be changed.

5.5.5 Short-term Effectiveness

There are significant short-term risks associated with the implementation of Alternative 4. Because of the amount of work involved, these significant short-term risks would be issues for 10 years. Potential increases in COC exposure during site preparation and implementation (a result of either direct exposure or by dust-borne releases during excavation and handling of impacted materials), could be mitigated through the use of appropriate health and safety practices and by compliance with a health and safety plan. However, the mass of materials to be handled (1,600,000 yd^3) and the area of disturbance (a total of 52 acres) increase the chances of exposure. The number of work hours spent onsite around heavy equipment would be significant over a 10-year project, increasing the risk of an accident as compared to an option where fewer hours are spent in active construction.

Implementation of Alternative 4 would affect the community for many years. Due to the volume of material to be handled, excavation and cell construction are expected to take 10 years. There will be noise impacts, the potential for dust-borne releases, increased traffic, and significant wear and tear on local roads during implementation. Excavation work is not confined to the warmer months, so excavation work would be carried out year-round, 5 days per week. Cell construction would be restricted to the Michigan construction season, which is typically late March or early April through the end of October, depending on weather.

Over the course of the project, more than 127,000 truck trips would be necessary to transport excavated material from the offsite outlying areas to the onsite disposal cells, to bring in clean fill, and to haul displaced materials to offsite disposal locations. During the approximately 5 years of the project when excavation and filling work would be the focus, there would be an average of 40 trucks per day in and out of OU1. There would be short-term environmental impacts associated with the potential for offsite migration due to dust-borne releases or incidental releases to Portage Creek given that 52 acres will be disturbed during the implementation of Alternative 4. The dust-borne releases could be readily mitigated by keeping the excavation/consolidation areas/materials appropriately wet, but the size of the area being disturbed increases the risk nonetheless.

Reasonable and appropriate controls (for example, silt curtains) would be implemented when removing materials that lie close to Portage Creek and wetland areas of OU1to mitigate impacts to the environments. The removal of materials beneath the Alcott Street and Goodwill parking lots would cause short-term impacts to neighboring properties/property owners. The excavations at these locations may reach 15 to 20 feet or more below grade, and are expected to require benching and/or sheet pile to allow removal to target depths. The installation and removal of sheet pile will create noise and cause vibrations in the immediate area during the period of construction, potentially disturbing nearby property owners/occupants.

Areas disturbed during implementation would be restored after construction with appropriate native plantings (or restored as wetland areas, if appropriate), and the habitat in the impacted areas would be expected to recover quickly.

5.5.6 Implementability

All the major components of Alternative 4 are proven, readily implementable, and expected to be reliable over long time scales. Administratively, this approach is implementable, and could be completed in 10 years assuming offsite disposal does not become a rate-limiting factor.

From a technical perspective, Alternative 4 is implementable using readily available, conventional earth-moving equipment. The necessary services and construction materials are expected to be readily available, and qualified commercial contractors with experience at other Kalamazoo River Superfund Site OUs are available locally to perform the work. Given the 10-year timeframe associated with this alternative, it is possible that onsite management of the project would be transferred at some point during construction, and support staff—both in the field and the office—would also be subject to turnover. While this type of transition is manageable, it is an issue of implementability to consider.

The sheet pile removal element of this alternative would also be a relatively straightforward effort. The necessary support equipment (a crane to hold the steel while it is being cut) is readily available. Offsite transport and disposal of the sheet pile is not anticipated since the steel should be able to be salvaged or sold.

The key issues with Alternative 4 are related to sequencing, space constraints, and landfill capacity. Given the quantity of materials targeted for excavation and disposal in the containment cells, the project would have to be carried out in phases. In each phase of the onsite work, soils from a particular area would have to be removed, temporarily staged to allow for construction of the base liner, and replaced in the cell. Then the cover system would be installed, and the crew would move on to the next area. The logistical issues associated with implementation of Alternative 4 could likely be complicated, and the complexity of the operation would increase as the project progresses. Soils would be excavated from one area, and temporarily staged in another while clean fill is brought in to establish the base elevation and the base liner is constructed. The need to add approximately 10 feet of clean fill to raise the bottom liner 4 feet above the water table will limit the amount of space available for disposal.

Approximately 75 percent of the soils from the Former Operational Areas would be placed/graded/compacted in the cell and the final cover would be constructed. The remaining 25 percent of the soils targeted for excavation and the soils excavated from the offsite outlying areas would be volumetrically displaced, which means that more than 500,000 yd^3 of materials would have to be transported offsite for disposal. As described in the implementability discussion for Alternative 3, the number of landfills available in southwest Michigan able to take large quantities of materials is limited. Even if appropriate disposal facilities are identified, the landfill capacity and other needs/restrictions (such as, no PCB-containing materials placed at the bottom of a disposal cell or near the leachate collection/drainage system) could limit the rate at which materials could be hauled offsite. If sufficient capacity in southwest Michigan is not available, facilities across a larger area would have to be considered. This would increase short-term risks since transport distances would be longer. Collectively, the factors could potentially increase the implementation timeframe.

Similar implementability issues as described in earlier alternatives would be encountered in the targeted offsite outlying areas located underneath existing parking lots. The excavations would need to be stabilized with temporary steel sheeting, and special implementation methods would be required to drive the sheets while minimizing the potential for damage to the adjacent structure. In addition, the same supplemental engineering controls described in the implementability section for Alternative 3 would be necessary in Alternative 4 to manage groundwater in the saturated fill. While the groundwater management measures will present additional design and construction challenges, they are technically feasible and implementable. Since OU1 is part of a CERCLA site, permits are not required for onsite activities; however, the substantive applicable requirements of federal and state regulations would need to be met.

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5.5.7 Cost

Costs for Alternative 4 are associated with the following construction activities: project area preparation, excavation, installation/construction of the containment cells, offsite disposal, sheet pile removal, restoration, and monitoring. The estimated costs associated with the implementation of Alternative 4 are presented in Table 5-10.

For Alternative 4, the total estimated capital cost of implementation is $131 million, and the total estimated O&M cost is $3.0 million. The total estimated periodic cost for 5-year reviews is $54,000. The total estimated 30-year present-worth cost associated with implementation of Alternative 4 is $134 million.

SECTION 6

66 Comparative Analysis of Remedial Alternatives

Each potential remedial alternative identified in Section 4 was evaluated in Section 5 against seven of the nine criteria in accordance with CERCLA guidance. The remaining criteria, state and community acceptance, will be evaluated in the ROD once formal comments on the FS and proposed plan have been received.

Section 6 provides a comparative analysis of the remedial alternatives. The following subsections summarize the primary advantages and disadvantages of each proposed alternative with regard to the seven criteria identified in Section 5. As described in CERCLA FS assessment guidance (USEPA 1988), "The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decision maker must balance can be identified." A summary table showing each remedial alternative relevant to the applicable criteria is included as Table 6-1.

PCBs were identified earlier in this report as the primary driver for cleanup at OU1 and other COCs are collocated with the PCBs. It is expected that by addressing PCBs in soil, sediment, and residuals, the remaining COCs will be addressed. For that reason, this section focuses mainly on the remediation of PCBs.

6.1 Overall Protection of Human Health and the Environment

Alternatives 2, 3, and 4 are each expected to be effective long-term remedies for OU1. Under these alternatives, the three RAOs would be achieved and ARARs would be met. As discussed in Section 1.4 and 1.6, the primary exposure pathways at OU1 are associated with the following:

- Direct contact
- Transport to Portage Creek or floodplain areas from erosion of exposed material with COCs above PRGs
- Transport of groundwater impacted by contaminated material
- Surface water runoff

The sources of PCBs and relevant COCs to groundwater, surface water, air, and sediments will be reduced by addressing PCBs in soils and sediments, because the PCBs are bound to the paper waste, which is found in isolation and intermixed into soils and sediments.

PCBs are located in the surface and subsurface soils and sediments onsite and in outlying areas. PCBs tend to adhere strongly to organic solids, such as those found in paper residuals and have a low solubility in water. The residuals are found on their own and intermixed into soils and sediments. The physicochemical properties of PCBs make them relatively immobile to leaching; however, the exposed soils and sediments are still susceptible to erosion and dust generation. Alternatives 2, 3, and 4 each involve excavation of exposed contaminated soils with consolidation onsite beneath a landfill cap or offsite disposal to reduce erosion.

The groundwater and seep samples with elevated PCB concentrations were generally located in areas of OU1 that were not addressed by IRM activities. The areas would be addressed in each of the Alternatives 2 through 4. Alternatives 2 and 4 include capping to prevent infiltration of surface water through the consolidated soils and to prevent leaching and colloidal transport. Under current conditions, PCBs are not migrating outside the waste via groundwater, so the addition of groundwater collection subalternatives to Alternative 2 options would not significantly increase their overall protectiveness. Alternative 3 includes complete removal and offsite disposal.

Alternative 1 would provide no improved protection over the current conditions, would provide no risk reduction, and would not be protective of human health or the environment. No RAOs would be achieved by Alternative 1. The overall protectiveness to human health and the environment is similar for each active remedial alternative as long as all elements of the remedy, including O&M and monitoring, are properly maintained, RAOs 1 through 3 would be achieved for Alternatives 2, 3, and 4, the significant difference being that with increasing complexity of remedy, there are increased short-term risks.

6.2 Compliance with Applicable or Relevant and Appropriate Requirements

Under Alternative 1, the requirements to reduce exposure or associated risk to acceptable levels, achieve an acceptable degree of protectiveness, and appropriately manage/operate disposal areas would not be achieved. The relevant action and location-specific ARARs vary among Alternatives 2, 3, and 4. Implementation of Alternative 2 options, 3 and 4 would result in the achievement of the identified ARARs.

6.3 Long-term Effectiveness and Permanence

With the exception of Alternative 1, each of the remaining alternatives would be expected to meet RAOs 1 through 3 and provide long-term effectiveness and permanence once the RAOs are met. The active alternatives are combinations of proven and reliable remedial processes, and the potential for failure of any individual component is low.

Alternative 2 options would achieve long-term effectiveness through onsite containment of the material with COCs above PRGs as a primary component of the remedy, with O&M, monitoring, and institutional controls to collectively ensure and verify the permanence of the remedy. Alternative 2C does not significantly increase the long-term effectiveness of the remedy through incineration of excavated material with PCB concentrations greater than 500 mg/kg because capping prevents direct contact and erosion and the PCBs are already largely immobile in the waste. Only materials excavated as a result of consolidation would be incinerated, residuals with concentrations greater than 500 mg/kg currently located in the Bryant HRDL/FRDL would remain. Under current conditions, PCBs do not appear to be migrating outside the waste via groundwater, so the addition of groundwater collection subalternatives to Alternative 2 options would not significantly increase their long-term protectiveness. Alternative 3 would achieve long-term effectiveness and permanence by removing all material with COC exceedances from OU1 and disposing of it at offsite solid waste landfills and TSCA facilities. The facilities selected for disposal would each require O&M monitoring and institutional controls to verify permanence. Alternative 4 would achieve long-term effectiveness and permanence by placing the PCB material into containment cells constructed onsite with O&M, monitoring, and institutional controls.

Under Alternative 3, no long-term O&M or monitoring would be required onsite with the exception of areas where waste is left in place because of the proximity to buildings. Materials with COC concentrations above relevant PRGs would be excavated and disposed of offsite. The large-scale removal and offsite disposal of materials presented in Alternatives 3 provides an added degree of permanence at OU1 through removal. Long-term effectiveness would be monitored at the offsite facilities.

Alternative 2 options are proven technologies that meet the requirements for effectiveness and permanence. Alternative 3 and 4 provide an added level of protectiveness because wastes are disposed of in lined containment cells. The main difference between Alternatives 3 and 4 is that the waste is moved and managed offsite in Alternative 3. The long-term monitoring and maintenance components to be implemented in conjunction with institutional controls under Alternative 2options, or 4 would provide the necessary mechanisms to verify that each remedy is performing as anticipated over time. As a result, Alternative 2, options 3 and 4, are expected to provide effective, permanent remedies.

6.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2C is the only alternative that would result in a reduction of toxicity or volume by treatment with the offsite incineration of a portion of excavated soils. Subalternatives (i) and (ii) provide a reduction in the contaminant volume in groundwater; however, minimal contaminant mass is present in the groundwater and is not seen outside of the waste. Treatment is not a component of any of the other remedial alternatives carried forward. Section 300.430(a)(iii)(B) of the NCP contains an expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat where treatment is impracticable. Alternative 1 does not reduce the toxicity, mobility, or volume of COC-impacted materials. Alternatives 2A, 2B, and 4 would reduce the mobility of COCs through isolation and containment. Only Alternative 2C would result in a reduction of toxicity or volume by treatment.

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TABLE 6-1
Comparative Analysis of Alternatives
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Description	Overall Protection	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility or Volume through Treatment	Short-term Effectiveness	Implementability	Cost
Alternative 1	No action	Not protective. No action would be taken.	Would not meet ARARs	Not effective. Site conditions would remain the same.	No reduction of toxicity, mobility, or volume.	No worker risks. No action to be taken.	Implementable as no action would be taken.	$54,000
Alternative 2	Consolidation and capping							
2A	Construct caps on both Monarch and Operations areas	Protective. Remaining exposed contamination would be covered and contained. Infiltration of surface water would be minimized.	Meets ARARS.	Effective.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, most effective of active alternatives. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts associated dust, noise, and traffic.	Proven technology that has been implemented at similar OUs.	$40 million
2B	Consolidate Monarch within Operations areas	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required.	Meets ARARS.	Effective.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, slightly longer than 2A. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts associated dust, noise and traffic.	Proven technology that has been implemented at similar OUs. Combining Monarch on the Operations area would reduce the footprint of contamination.	$39 million
2C	Consolidate Monarch within operations areas and transport excavated soils with PCBs >500 mg/kg offsite for incineration	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required. Offsite incineration of some of the highest PCB concentrations would be slightly more protective.	Meets ARARs	Effective.	Reduction of toxicity and volume through treatment of a portion of the material.	Implementation over 2-year period, slightly longer than 2A and 2B. Worker risk associated with dermal contact, inhalation, and ingestion due to increased management with characterization and segregation. Risks are controllable. Community impacts associated dust, noise, traffic, and offsite transportation of contaminated materials.	Proven technology that has been implemented at similar OUs. Combining Monarch on the operations area would reduce the footprint of contamination. TSCA-permitted incinerators are limited quantity.	$60 million
Subalternative (i)	Groundwater collection and treatment system	Protective. Achieves RAO 3 with collection and treatment of potentially impacted groundwater.	Meets ARARs	Effective.	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Manageable risk associated with the installation of wells and construction of treatment system.	Proven technology.	$3.0 million (2A) or $2.9 million (2B and 2C)
Subalternative (ii)	Groundwater collection and treatment system with slurry wall	Achieves RAO 3 with collection and treatment of potentially impacted groundwater, but may create mounding or otherwise alter groundwater flow.	Meets ARARs	Effective.	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Increased short-term risks to construction worker and environment over subalternative (i) during installation of the slurry wall. Community impacts from dust, noise and traffic associated with the slurry wall construction.	Proven technology. Implementation may result in groundwater mounding or short-circuiting around the barrier if operation of the groundwater treatment system ceased.	$12 million (2A) or $10 million (2B and 2C)

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TABLE 6-1
Comparative Analysis of Alternatives
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Description	Overall Protection	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility or Volume through Treatment	Short-term Effectiveness	Implementability	Cost
Alternative 3	Total Removal and Offsite Disposal	Protective. Contamination would be disposed of at an approved landfill facility both hazardous and non-hazardous.	Meets ARARS.	More effective than Alternative 2 due to removal from OU1. No cover maintenance or source for potential groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved. Volume may be increased if soils require dewatering by addition of cement.	Implementation over 5-year period. Worker risk associated with dermal contact, inhalation and ingestion would occur over a longer period of time. Risks are controllable. Community impacts associated dust, noise, and traffic.	Proven technology, landfill space in the area could be limited requiring the hauling of waste a significant distance from OU1.	$366 million
Alternative 4	Encapsulation Containment System	Protective. Little advantage achieved by construction of the liner. Compacted waste can achieve $10E^{-7}$ centimeters per second hydraulic conductivity on its own limiting groundwater flow through the material.	Meets ARARS.	More effective than Alternative 2. The source material is fully encapsulated further minimizing potential for groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 10-year period. Worker risk associated with dermal contact, inhalation, and ingestion would occur over a longer period of time. Risks are controllable. Community impacts associated dust, noise is the least short-term effective alternative.	Proven technology.	$134 million

6.5 Short-term Effectiveness

The evaluation of short-term effectiveness criterion are primarily related to the area and volume of COC-containing materials addressed in each alternative, the time necessary to implement the remedy, potential risks to workers, and potential impacts to the community during construction. Short-term effectiveness is summarized in Table 6-2.

TABLE 6-2
Summary of Short-term Effectiveness Considerations
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Total Area Addressed	Total Volume of COC-Containing Materials Excavated	Duration	Worker Risks	Community Impacts
Alternative 1	No areas addressed	No volume of impacted PCB-containing materials addressed	No time period to implement	No worker risks from implementation as no action is taken.	Potential offsite migration of COC-containing materials.
Alternative 2A	42 acres	395,000 yd^3	Approximately 2 years	Least of the active alternatives; managed by health and safety plan.	Associated with dust, noise, and truck traffic.
Alternative 2B	42 acres	550,000 yd^3	Approximately 2 years	Slightly increased due to moving Monarch HRDL; managed by health and safety plan.	Slight increase; associated with dust, noise, and truck traffic.
Alternative 2C	42 acres	550,000 yd^3	Approximately 2 years	Greater than 2A and 2B due to potential exposure during characterization and transportation.	Greater than 2A and 2B due to additional management for characterization and offsite transport.
Subalternative (i)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Risks are easily managed by health and safety plan. Continued risks present with operation and maintenance of treatment system.	Slight increase over Alternative 2 options during construction due to well installation and treatment system construction.
Subalternative (ii)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Greater risks than subalternative (i) due to construction of slurry wall. Similar O&M risks.	Slight increase over Alternative 2 options during construction due to well installation and treatment system construction. Greater than subalternative (i) due to slurry wall construction.
Alternative 3	52 acres	1,600,000 yd^3	5 years	Greater than Alternative 2 given the area/volume of targeted material; Increased travel for disposal and increased project duration.	Greater than Alternative 2; associated with noise, dust, and particularly increased truck traffic, which would average 40 trips daily in and out of OU1 for the duration of the project. Greatest number of miles driven due to volume transported to disposal

TABLE 6-2
Summary of Short-term Effectiveness Considerations
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Total Area Addressed	Total Volume of COC-Containing Materials Excavated	Duration	Worker Risks	Community Impacts
					facilities with limited locations.
Alternative 4	52 acres	1,600,000 yd^3	10 years	Greater than Alternatives 2 and 3 given the area/volume of targeted material and significantly increased project duration.	Greater than Alternatives 2 and 3; associated with noise and dust over the longest project duration. Slightly more truck trips than Alternative 3, but 1/3 of the miles outside OU1 due to decreased volume transported to disposal facilities.

With the exception of Alternative 1, all the alternatives with active remedial components would have some short-term impacts including increased noise from construction vehicles, the potential for airborne dust releases, increased traffic in the vicinity of OU1, increased wear on local roads, increased potential for workers to come in contact with PCB-containing materials, and other risks associated with construction work. Alternative 2 options, require the least amount of disturbance and shortest construction time. The impacts can be effectively addressed through implementing a project-specific health and safety plan, keeping excavation areas properly wetted, planning truck routes to minimize disturbances to the surrounding community, and other standard best management practices. The addition of groundwater subalternatives to Alternative 2 options would result in greater short-term impacts as they increase the construction period and the amount of local truck traffic associated with site activities. Installation of the subalternatives would also require more mitigation to prevent releases to Portage Creek during installation.

Alternatives 3 and 4 present greater short-term impacts because of the amount of materials required to be moved and the increased construction duration. The project duration for the alternatives is longer than Alternative 2 options, increasing both construction-related and exposure risks to workers. The additional volume of materials to be handled in Alternatives 3 and 4 also result in an increase in truck traffic in the vicinity of OU1 during the project. During the implementation of Alternative 3, there would be an average of 40 truck trips per day, year-round, for approximately 5 years. During the excavation and backfilling work under Alternative 4, there would be an average of 40 trips per day into and out of OU1 for approximately 6 years. The increase in truck traffic results in an increased risk for vehicular accidents.

There are additional qualitative impacts to the local community, such as noise and dust, for a period of 5 years (Alternative 3) to 10 years (Alternative 4), which will place an increased burden on the community. There are no short-term impacts associated with construction or implementation for Alternative 1; however, since existing measures in place to control access to OU1 would not be maintained, there could be an increased risk of direct exposure over the short term to individuals who trespass and come into contact with surficial materials containing COCs above the PRGs.

6.6 Implementability

The primary remedial components of Alternative 2, options 3 and 4, are proven, readily implementable, have been used successfully as part of other environmental cleanup projects, and they are expected to be reliable over the long term. All the alternatives are administratively implementable, and although no permits would be required, the substantive applicable requirements of federal and state regulations would be met. The addition of groundwater subalternatives i or ii to Alternative 2 options would not be significantly more difficult to implement. There could be long-term implementability issues with subalternative ii as installation of slurry wall could create problems associated groundwater mounding.

Alternative 2, options 3 and 4, could all be completed using readily available conventional earth-moving equipment, and most of the necessary services and construction materials are expected to be readily available. Qualified commercial contractors with experience at other areas of the Kalamazoo River Superfund Site are available locally to perform the work.

Alternatives 3 and 4 are more difficult to implement due to different constraining conditions. For Alternative 3, the availability of solid waste and/or TSCA landfills to accept the volume of materials to be disposed of offsite would be a limiting factor in terms of construction progress and overall cost. The limited staging area available for excavated materials during construction of the containment cells would be a limiting factor for Alternative 4.

6.6.1 Disposal Availability

There are a very limited number of TSCA-permitted incinerators nationwide. As a result, Alternative 2C incorporates travel a minimum of 1,200 miles by rail to an incinerator for disposal. While still implementable, the long transport distances result in increased short-term risks and escalated costs.

There are few solid waste landfills in southwest Michigan that are available to accept PCB-containing material, regardless of whether that material meets solid waste regulatory requirements. The facilities commonly have limits on disposal capacity and disposal rates that may affect the timely completion of Alternative 3 and 4 in which a large volume of PCB- and other COC-containing material would be disposed of offsite. It is also possible that the combined disposal capacity in all of the nearby solid waste facilities and TSCA landfills would be insufficient for the large volumes of PCB-containing material proposed for disposal under Alternative 3. The result could be increased transport distances for offsite disposal, and consequentially increased risks and costs.

6.6.2 Construction of the Containment Cells

Additional implementability challenges associated with the construction of the containment cells in Alternative 4 include sequencing and space constraints, developing a plan for excavating 1,600,000 yd^3 of COC-containing materials, constructing the full-encapsulation disposal cells, and replacing the excavated materials in the cells. As each containment cell is sequentially constructed, a successively smaller area will be available onsite for staging of clean materials and temporary storage of COC-containing materials. Eventually, onsite capacity will be depleted, and a substantial volume of material will have to be disposed of offsite. Approximately 25 percent of the soils targeted for excavation and placement in the Former Operational Areas and all of the soils excavated from the offsite areas would be volumetrically displaced, resulting in 500,000 yd^3 of materials being transported offsite for disposal, which would have a significant impact on both the implementation and cost of this alternative.

The control and management of surface water runoff from the temporarily stored COC-containing materials also will become increasingly challenging as less area is available for the operations under Alternative 4.

There may be local community resistance to trucks transporting COC-containing materials from OU1 over local roads en route to offsite disposal facilities under Alternatives 3 and 4, which are estimated to take 5 years and have 6 years of traffic impacts, respectively.

There are no technical or administrative implementability issues associated with Alternative 1 because no active remediation would take place.

6.7 Cost

The costs for the range of alternatives and subalternatives presented in this FS are summarized in Table 6-3. The detailed estimates and associated assumptions are presented in Tables 5-1 through 5-10. The cost estimates are consistent with FS-level of estimation, with an accuracy of +50 to -30 percent. A final cost estimate would be developed and refined during the remedial design process after the selection of a recommended remedy. Alternative 1 has no associated capital or O&M costs since there would be no further actions taken, but does require 5-year reviews as shown with periodic costs.

TABLE 6-3
Summary of Remedial Alternative Costs
OU1 Feasibility Study Report—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Estimated Capital Cost	Estimated O&M Cost	Estimated Periodic Cost	Total Present-worth Cost
Alternative 1	$0	$0	$54,000	$54,000
Alternative 2A	$36 million	$4.0 million	$54,000	$40 million
Subalternative (i)	$1.6 million	$1.5 million		$3.1 million
Subalternative (ii)	$10 million	$1.5 million		$12 million
Alternative 2B	$36 million	$3.0 million	$54,000	$39 million
Subalternative (i)	$1.5 million	$1.5 million		$3.0 million
Subalternative (ii)	$8.6million	$1.5 million		$10 million
Alternative 2C	$57 million	$3.0 million	$54,000	$60 million
Alternative 3	$366 million	$0	$54,000	$366 million
Alternative 4	$131 million	$3.0 million	$54,000	$134 million

Note: Costs for subalternative (i) and (ii) for Alternative 2C are the same as Alternative 2B.

SECTION 7

77 References

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Appendix A
Supplemental Groundwater Investigation Report

Appendix B
PRG Technical Memorandum

Appendix C
Allied Zoning Map

Appendix D
Selected RI Tables and Figures

Appendix E
Allied Paper Landfill Hot Spot Analysis